UNION SWITCH
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A member of the ANSALDO Group
5800 Corporate Drive Pittsburgh, PA 15237

SERVICE MANUAL 6408F

Description, Installation and Operation

PRCCI

PROGRAMMABLE REMOTE CODE TO COMPUTER INTERFACE

US&S GENISYS APPLICATION

March, 1990
A-3/90-50-2917-1

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SECTION I

GENERAL INFORMATION

1.1 INTRODUCTION

This manual describes the installation and operation of the Union Switch & Signal Programmable Remote Code to Computer Interface (PRCCI) applied as an office code unit to a GENISYS code system. The information in this manual supplements service manual 6408, Hardware Description and Installation, with information on firmware installation, DIP switch programming, communications, and general operation.

The term "application", as used by this manual, refers to a PRCCI applied to any GENISYS code line. The term "installation" refers to a PRCCI applied to a specific code line at a specific site. The term "office" refers to the CTC office computer system.

1.2 OVERVIEW

The PRCCI is a microprocessor based device whose primary purpose is to logically interface a CTC office computer system to a single field code line. The unit serves as the mechanism by which the office delivers control information and receives indication information. The unit, once initialized, functions independently of the office and may directly manipulate the code line interface without intervention from the office. Manipulation of the code line interface to transmit and receive information is transparent to the office. The office itself is only concerned with the buffered information that represents code line data. Control information from the office is buffered by the PRCCI until such time that it can be transmitted on the code line. Indication information from the code line, as well as certain types of status information, is also buffered by the PRCCI until such time that it can be transmitted to the office.

1.3 ARCHITECTURE

The PRCCI design incorporates a dual-microprocessor architecture. These microprocessors reside on separate but identical printed circuit boards (CPU A and CPU B). The two processor boards communicate with each other over an internal, asynchronous, serial data channel. CPU A is the master on this circuit and CPU B is permitted to respond only when addressed. CPU A is primarily responsible for communication with the office. This includes the implementation of the office protocol on both the normal (J1) and standby (J2) channels, as well as the interactive

maintenance session. CPU B is primarily responsible for code line communication and control of the front panel display. A ribbon cable connects CPU B with the interface board. The interface board physically provides the processor access to the line/local inputs and outputs as well as the discrete LEDs and alphanumeric display on the front panel. This configuration allows for optimum utilization of each processor while minimizing inter-processor communication.

1.4 FLOW OF INFORMATION

Information from an office is first received by CPU A and subjected to lower level hardware and protocol level verification. CPU A informs CPU B that information has been received and determines if the message is addressed to the unit and requires further processing.

Certain classes of messages are processed directly by CPU A. The responses to these messages are determined by CPU A. Most classes of messages however, require that CPU A pass the received message to CPU B for additional verification and subsequent processing. In general, for these messages, the response of CPU B determines the response of CPU A to the office. CPU B may typically respond to CPU A with any buffered information that it has at the time. This excludes certain maintenance session messages that require specific responses and cases where messages fail verification by CPU B. Regardless of the level of activity in office communication, CPU A regularly polls CPU B for information. This allows to unit to detect internal failures and, to a certain extent, function independently of office communication.

SECTION II

INSTALLATION

2.1 APPLICATION FIRMWARE

All PRCCI applications require specific Erasable Programmable Read Only Memory (EPROM) sets to be installed in each CPU board. Each set is assigned a part number and is ordered separately from the PRCCI unit itself. Each EPROM within a set is identified by an individual part number for manufacturing and distribution purposes. A label on each EPROM specifies individual EPROM part number, revision level, IC socket, and CPU board (A or B) assignments.

When installing or removing an EPROM, keep the device aligned squarely with the socket to prevent bending and breaking the pins. Do not install an EPROM with bent, broken, or severely fatigued pins. They could break off within the socket, possibly requiring removal and replacement of the socket. The notches in the socket and EPROM must be aligned to avoid damage to the device when power is applied.

Random Access Memory (RAM) IC devices are necessary for operation of each cpu board. The exact number required varies with each EPROM set and may change from one revision to the next. As a general rule, any of the IC sockets IC10, IC11, IC12, IC13, IC14, and IC15 that are not used for the EPROM set, should contain RAM devices. IC socket IC9 must always contain a RAM device while IC socket IC16 must always contain the designated EPROM from the set.

2.2 CPU A CONFIGURATION

The GENISYS application of the PRCCI requires EPROM set number N451800-0114 installed in CPU A. This is a general purpose set, also used in other PRCCI applications. It primarily supports communication with the office computer system and provides the maintenance session capability.

Unless dictated by the installation, all jumpers on the board should be placed in the standard positions. Switches SW1, SW2, SW3, SW4, SW5, and SW6 must be placed in the EPROM position. Refer to the Hardware Description and Installation service manual for information on the standard positions of these items. Any variations from the standard positions should be reflected in site specific plans.

DIP switch packs SW7 and SW8 are used to select various parameters that affect communication with the office computer system. Programming of these switches is dictated by the installation and should be reflected in site specific plans. SW9 is not used and all switches should be placed in the closed position. The PRCCI must be reset for any switch changes to take effect.

2.2.1 PRCCI Address Selection

The address assigned to the PRCCI must be programmed into SW7. It is entered as an eight bit, binary value between 1 and 255 (decimal). An address of zero (all switches closed) is illegal. Figures 2-1 and 2-2 give the binary weighted values of the switches in SW7 and some examples of address selections.

2.2.2 Office Baud Rate Selection

The baud rate used to communicate with the office must be programmed into SW8. The rate selected is used on both the normal (J1) and standby/maintenance (J2) channels. Figures 2-3 and 2-4 list the switch assignments and their options.

2.2.3 Office Transmit Key-on Delay Selection

The key-on delay time used in communication with the office must be programmed into SW8. The delay time selected is used in the transmission of responses to the office on the both the normal (J1) and standby/maintenance (J2) channels. This parameter, measured in bit times, determines the time between the assertion of request to send (RTS) and the beginning of data transmission. A nominal 4 bit times is recommended to compensate for carrier turn-on delay. The key-on delay may have to be lengthened to compensate for any additional delays imposed by modems, repeaters, leased circuits, or microwave equipment. Figures 2-3 and 2-5 list the switch assignments and their options.

A typical repeater characteristically delays and shortens the carrier key-on signal (RTS) by some pre-determined time. This time is typically measured in bit times and is specific to the type of repeater used. Consult documentation on the specific repeater(s) in use for the delay times imposed. If that information is not available allow a nominal 3 bit time delay for an amplifier repeater and a nominal 7 bit time delay for a regenerative repeater.

2.2.4 Office Transmit Key-off Delay Selection

The key-off delay time used in communication with the office must be programmed into SW8. The delay time selected is used in the transmission of responses to the office on the both the normal (J1) and standby/maintenance (J2) channels. This parameter, measured in bit times, determines the time between the end of data transmission and the de-assertion of request to send (RTS). A nominal 4 bit times is recommended to ensure that all data bits have transmitted on the carrier circuit and to help prevent transients that could reduce data integrity. The key-off delay may have to be lengthened to compensate for any

additional delays imposed by modems, repeaters, leased circuits, or microwave equipment. Figures 2-3 and 2-5 list the switch assignments and their options.

A repeater, particularly a regenerative as opposed to an amplifier, may tend to buffer and delay the transmission of data. Consult documentation on the specific repeater(s) in use for the delay that it may impose. If that information is not available allow a nominal 7 bit time delay for a regenerative repeater. Allow a nominal 4 bit times for carrier modulation/demodulation delay in an amplifier repeater.

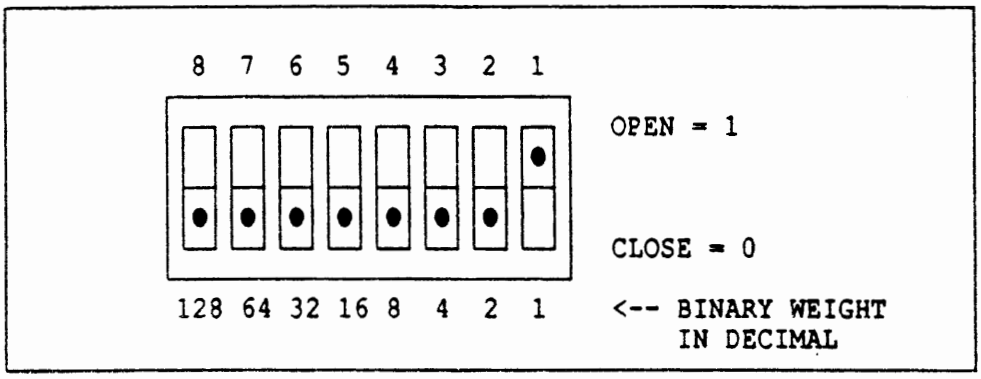


Figure 2-1. Binary Weights For Switch Positions

SW7: 8 7 6 5 4 3 2 1	PRCCI ADDRESS
C C C C C C C C	ILLEGAL
C C C C C C C O	1
C C C C C C O C	2
C C C C C C O O	3
C C C C C O C C	4
C C C C C O C O	5
C C C C C O O C	6
C C C C C O O O	7
C C C C O C C C	8
...	...
O O O O O O C O	253
O O O O O O O C	254
O O O O O O O O	255

Figure 2-2. PRCCI Address Examples

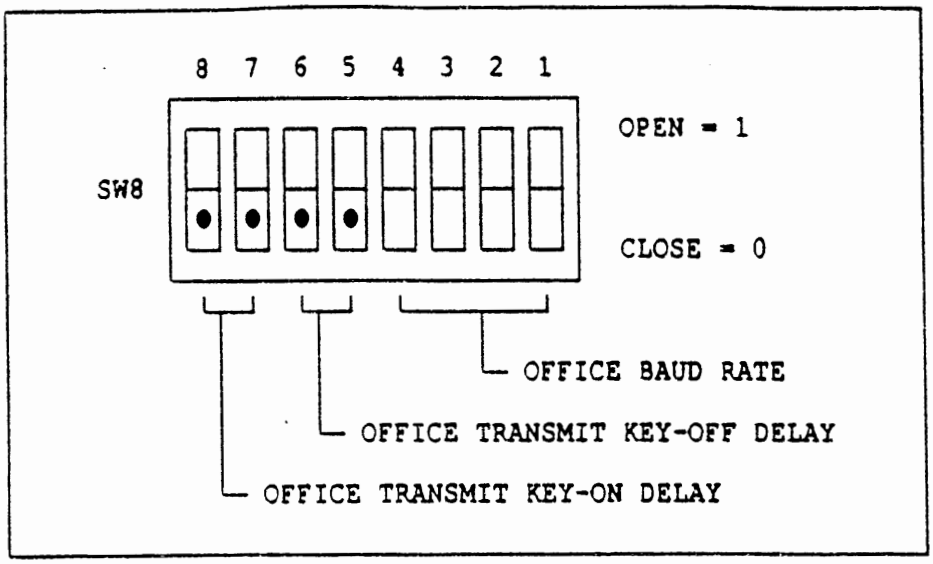


Figure 2-3. SW8 Switch Assignments (CPU A)

SW8: 4 3 2 1	OFFICE BAUD RATE
C C C C	1200
C C C O	50
C C O C	75
C C O O	110
C O C C	134
C O C O	150
C O O C	300
C O O O	600

SW8: 4 3 2 1	OFFICE BAUD RATE
O C C C	1200
O C C O	2400
O C O C	4800
O C O O	9600
O O C C	19200
O O C O	1200
O O O C	1200
O O O O	1200

Figure 2-4. Office Baud Rate Options

SW8: 8 7	OFFICE TRANSMIT KEY-ON DELAY
C C	4 BIT TIMES
C O	8
O C	16
O O	32

SW8: 6 5	OFFICE TRANSMIT KEY-OFF DELAY
C C	4 BIT TIMES
C O	8
O C	16
O O	32

Figure 2-5. Office Transmit Key-on/off Delay Options.

2.3 CPU B CONFIGURATION

The GENISYS application of the PRCCI requires EPROM set number N451800-0105 installed in CPU B. This is a special purpose set, unique to this application, that enables the PRCCI to communicate with a GENISYS code system.

Unless dictated by the installation, all jumpers on the board should be placed in the standard positions. Switches SW1, SW2, SW3, SW4, SW5, and SW6 must be placed in the EPROM position. Refer to the Hardware Description and Installation service manual for information on the standard positions of these items. Any variations from the standard positions should be reflected in site specific plans.

DIP switch packs SW7, SW8, and SW9 are used to select various parameters associated with field communication. The PRCCI must be reset to affect any switch changes.

2.3.1 Code System Type

The code system type must be programmed into SW7. It must be programmed as shown in Figure 2-6 for PRCCI to function in a GENISYS application.

2.3.2 No Response Timeout Selection

The no response timeout must be programmed into SW7. This parameter, measured in milliseconds, determines the length of time that the PRCCI waits for a response to each message that it transmits. For proper operation, the time selected must be equal to or greater than the time required to transmit the ETX ($F6) and receive the message header ($F1, $F2, or $F3) from a field response. The options available are listed in figure 2-7.

To calculate this time, consider the possible delay factors listed below and determine the time associated with each. Select a DIP switch option that exceeds the total time of all delay factors. For factors measured in bit times, refer to figure 2-13 to convert a single bit time to milliseconds at the selected baud rate. Factors to be considered in the no response timeout calculation include:

1. The baud rate of the circuit. This time is typically represented in units of bits per second and should be converted to milliseconds for this calculation. Calculate the time for 2 characters at the given baud rate. Assume 10 bits per character unless 2 stop bits or parity has been enabled, in which case use 11 bits per character.

2. Maximum Field key-on delay. This delay is typically represented in units of bit times and should be converted to milliseconds for this calculation. Properly selected key-on delays in the field should already take carrier delays, such as repeaters, into consideration.

3. Carrier modulation/demodulation delay. The signal modulation and demodulation circuits internal to medium speed (300 to 1200 BPS) FSK modems and repeaters typically impose a delay on data throughput. This delay is typically measured in bit times and is specific to the type of equipment used. Consult documentation on the particular type of equipment in use. If information is not available allow a nominal 4 bit time delay for each time that the carrier signal must be (re-)modulated and demodulated.

4. Carrier propogation delay. On open line wire a carrier signal propagates at approximately 179,000 miles/second or about 0.56 milliseconds for every 100 miles. In #19 cable a carrier signal propagates at approximately 46,900 miles/second or about 2.13 milliseconds for every 100 miles.

5. Leased telephone circuits may impose additional delays. The characteristics and magnitude of such delays may be specific to the supplier. Under normal circumstances this calculation should be based on the maximum allowable delay as prescribed by current tariff regulations.

6. Any other possible source of carrier delay, such as a microwave link, that is unique or specific to the installation. If such a source exists, be sure to consider the maximum delay that could be imposed, not just an average delay.

2.3.3 Baud Rate Selection

The baud rate used by the PRCCI to communicate on the field communication (J3) channel must be programmed into SW8. The rate selected is used as both the normal and alternate baud rate in communication with the field code units. Programming is dictated by the installation and should be reflected in site specific plans. Figures 2-8 and 2-9 list the switch assignments and their options.

2.3.4 Stop Bit Selection

The number of stop bits used by the PRCCI to communicate on the field communication (J3) channel must be programmed into SW8. By placing SW8:5 in the closed position 1 stop bit is selected. By placing SW8:5 in the opened position 2 stop bits are selected. Figure 2-8 shows this switch in the closed position since only 1 stop bit is typically used on GENISYS code lines installed by US&S.

The selection of 2 stop bits may become necessary when certain types of repeaters are in use on the code line. These devices may clip and shorten a single stop bit, preventing successful communication between the PRCCI and the field code unit(s). For proper operation a minimum of 1.5 stop bits must be received by the PRCCI when the 2 stop bit option has been selected.

2.3.5 Parity Enable/Disable

The use of parity on the field communication (J3) channel must be programmed into SW8. By placing SW8:6 in the closed position parity generation and checking is disabled. By placing SW8:6 in the opened position parity generation and checking is enabled. Figure 2-8 shows this switch in the closed position since parity is not typicaly enabled on GENISYS code lines installed by US&S.

2.3.6 Parity Selection

The type of parity implemented on the field communication (J3) channel must be programmed into SW8 if the use of parity has been enabled. By placing SW8:7 in the closed position odd parity is selected. By placing SW8:7 in the opened position even parity is selected. Figure 2-8 shows this switch in the closed position as a default since parity is not typically enabled.

2.3.7 Transmitter Key-on Delay Selection

The transmitter key-on delay imposed by the PRCCI on the field communication (J3) channel must be programmed into SW9. This parameter, measured in bit times, determines the time between the assertion of request to send (RTS) and the beginning of data transmission. Typically, a nominal 4 bit times is recommended to compensate for carrier turn-on delay. The key-on delay may have to be lengthened to compensate for any additional delays imposed by modems, repeaters, leased circuits, or microwave equipment. Figures 2-11 and 2-12 list the switch assignments and their options.

A typical repeater characteristically delays and shortens the carrier key-on signal (RTS) by some pre-determined time. This time is typically measured in bit times and is specific to the type of repeater used. Consult documentation on the specific repeater(s) in use for the delay times imposed. If that information is not available allow a nominal 3 bit time delay for an amplifier repeater and a nominal 7 bit time delay for a regenerative repeater.

2.3.8 Transmitter Key-off Delay Selection

The transmitter key-off delay imposed by the PRCCI on the field communication (J3) channel must be programmed into SW9. This parameter determines the time between the end of data transmission and the de-assertion of request to send (RTS). Typically, a nominal 4 bit times is recommended to ensure that all data bits have been transmitted on the carrier circuit and to help prevent transients that could reduce data integrity. The key-off delay may have to be lengthened to compensate for any additional delays imposed by modems, repeaters, leased circuits, or microwave equipment. Figures 2-11 and 2-12 list the switch assignments and their options.

A repeater, particularly a regenerative as opposed to an amplifier, may tend to buffer and delay the transmission of data. Consult documentation on the specific repeater(s) in use for the delay that it may impose. If that information is not available allow a nominal 7 bit time delay for a regenerative repeater. Allow a nominal 4 bit times for carrier modulation/demodulation delay in an amplifier repeater.

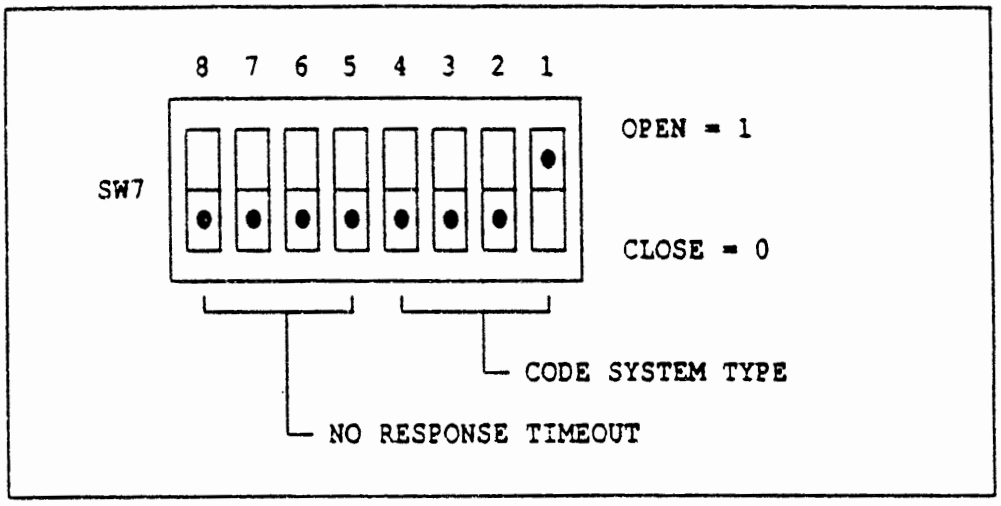


Figure 2-6. SW7 Switch Assignments (CPU B)

SW7: 8 7 6 5	NO RESPONSE TIMEOUT (MS)
C C C C	10
C C C O	20
C C O C	50
C C O O	100
C O C C	150
C O C O	200
C O O C	250
C O O O	300

SW7: 8 7 6 5	NO RESPONSE TIMEOUT (MS)
O C C C	350
O C C O	400
O C O C	450
O C O O	500
O O C C	750
O O C O	850
O O O C	1000
O O O O	1250

Figure 2-7. No Response Timeout Options

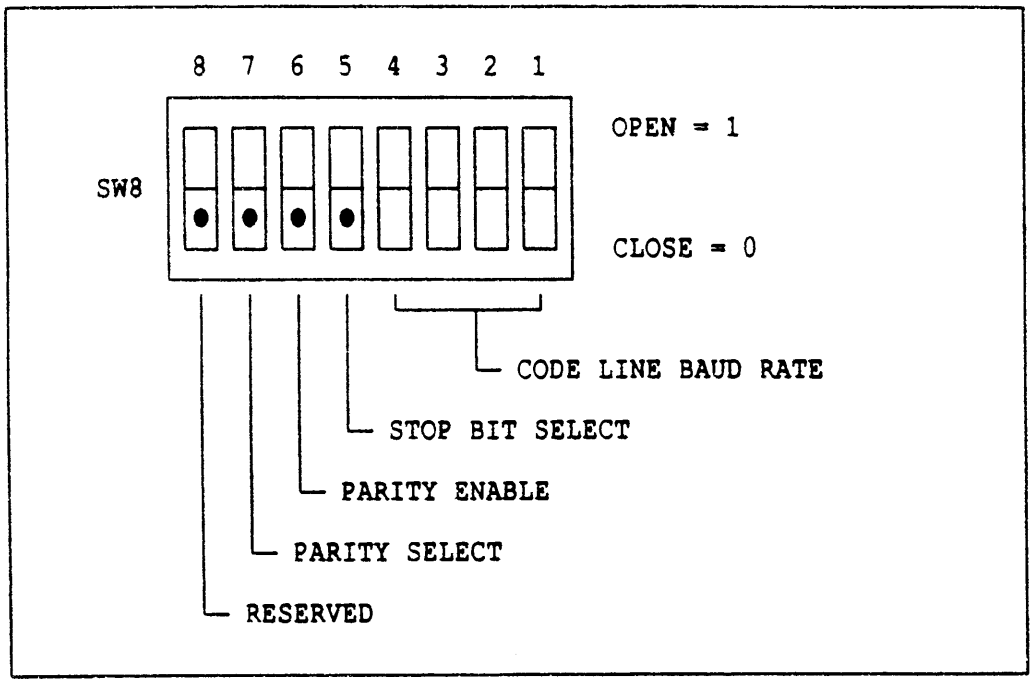


Figure 2-8. SW8 Switch Assignments (CPU B)

SW8: 4 3 2 1	CODE LINE BAUD RATE
C C C C	1200
C C C O	1200
C C O C	1200
C C O O	1200
C O C C	1200
C O C O	150
C O O C	300
C O O O	600

SW8: 4 3 2 1	CODE LINE BAUD RATE
O C C C	1200
O C C O	2400
O C O C	4800
O C O O	9600
O O C C	1200
O O C O	1200
O O O C	1200
O O O O	1200

Figure 2-9. Baud Rate Options

SW8: 7 6 5	PARITY / STOP BIT SELECTIONS
X X C	ONE STOP BIT
X X O	TWO STOP BITS
X C X	DISABLE PARITY
C O X	ENABLE ODD PARITY
O O X	ENABLE EVEN PARITY

Figure 2-10. Parity/Stop Bit Options

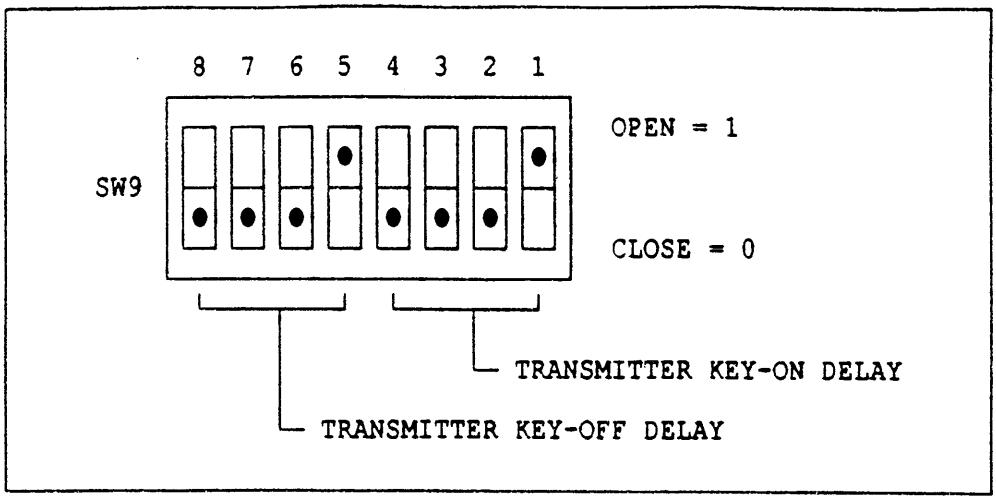


Figure 2-11. SW9 Switch Assignments (CPU B)

SW9: 4 3 2 1	KEY-ON DELAY (BIT TIMES)
C C C C	0
C C C O	4
C C O C	8
C C O O	12
C O C C	16
C O C O	20
C O O C	24
C O O O	28
O C C C	32
O C C O	36
O C O C	40
O C O O	44
O O C C	48
O O C O	52
O O O C	56
O O O O	60

SW9: 8 7 6 5	KEY-OFF DELAY (BIT TIMES)
C C C C	0
C C C O	4
C C O C	8
C C O O	12
C O C C	16
C O C O	20
C O O C	24
C O O O	28
O C C C	32
O C C O	36
O C O C	40
O C O O	44
O O C C	48
O O C O	52
O O O C	56
O O O O	60

Figure 2-12. Transmitter Key-on/off Delay Options.

BAUD RATE (BITS/SEC)	BIT TIME (MS/BIT)
150	6.6667
300	3.3333
600	1.6667
1200	0.8333
2400	0.4167
4800	0.2083
9600	0.1042

Figure 2-13. Bit Time Table.

2.4 CTC OFFICE INTERFACE

The CTC office system communicates with a PRCCI over either a normal or standby asynchronous, serial channel. Both are available at connectors J1 (NORMAL) and J2 (STANDBY/MAINT), located at the rear of the unit. The office protocol is only permitted to be active on one channel at a time. The standby channel, when not active with the office protocol, may be connected to an ANSI standard terminal to access the maintenance session. This channel functions in only one mode at a time. The office protocol, regardless of whether a maintenance session is opened or not, always takes precedence.

Both channels utilize a word format of 1 start bit, 8 data bits, no parity, and 1 stop bit. The baud rate is selectable with DIP switches and both operate at the same speed.

The transmission of a character requires that the circuit transition from an idle MARK state to the SPACE state for one bit time. This first transition is called the start bit. During the next eight bit times, the circuit transitions between MARK and SPACE, as required, to represent the character. The least significant bit of the character is transmitted first. The circuit is then forced to the MARK state for a minimum of one bit time. This final state is called the stop bit. Its primary functions are to frame the transmitted character and to ensure that the next start bit may be recognized as a MARK to SPACE transition. Figure 2-14 depicts the asynchronous character format utilized on the circuit.

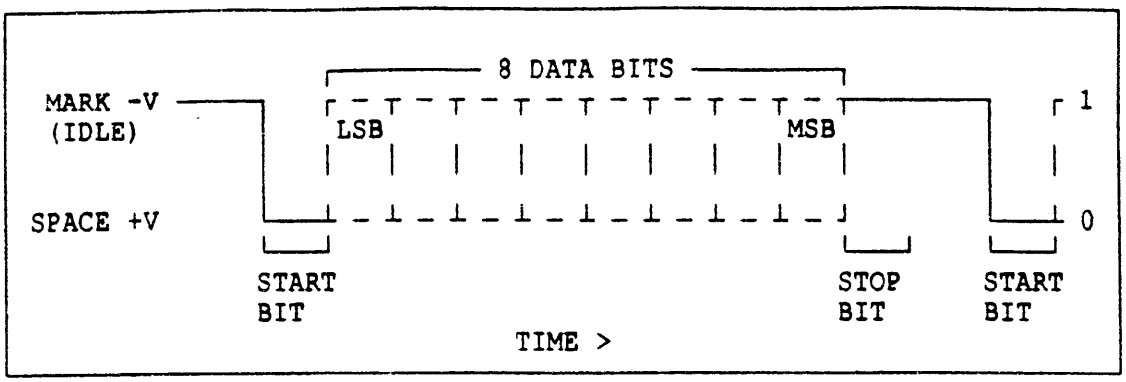


Figure 2-14. Asynchronous Character Format (Office)

As discussed in the Hardware Description and Installation service manual, these channels are RS232C compatible. Figure 2-15 provides interface specifications for the available signals. In figure 2-16, a typical office interface is shown using multiple, remotely located PRCCI units connected, through an EIA bridge, to a modem.

SIGNAL	PIN	STATE	VOLTAGE	DIRECTION
TXD TRANSMIT DATA	2	MARK SPACE	-3 TO -15 +3 TO +15	OUTPUT
RXD RECEIVE DATA	3	MARK SPACE	-3 TO -15 +3 TO +15	INPUT
RTS REQUEST TO SEND	4	OFF ON	-3 TO -15 +3 TO +15	OUTPUT
CTS CLEAR TO SEND	5	OFF ON	-3 TO -15 +3 TO +15	INPUT
DSR DATA SET READY	6	OFF ON	-3 TO -15 +3 TO +15	INPUT
SIGNAL GROUND	7	---	0	---
DCD DATA CARRIER DETECT	8	OFF ON	-3 TO -15 +3 TO +15	INPUT
DTR DATA TERMINAL READY	20	OFF ON	-3 TO -15 +3 TO +15	OUTPUT

NOTES:

1) VOLTAGES REFERENCED TO SIGNAL GROUND

2) DATA STATE IS UNDEFINED IN TRANSITIONAL REGION BETWEEN -3 AND +3 VOLTS.

Figure 2-15. RS-232C Compatible Interface Specifications

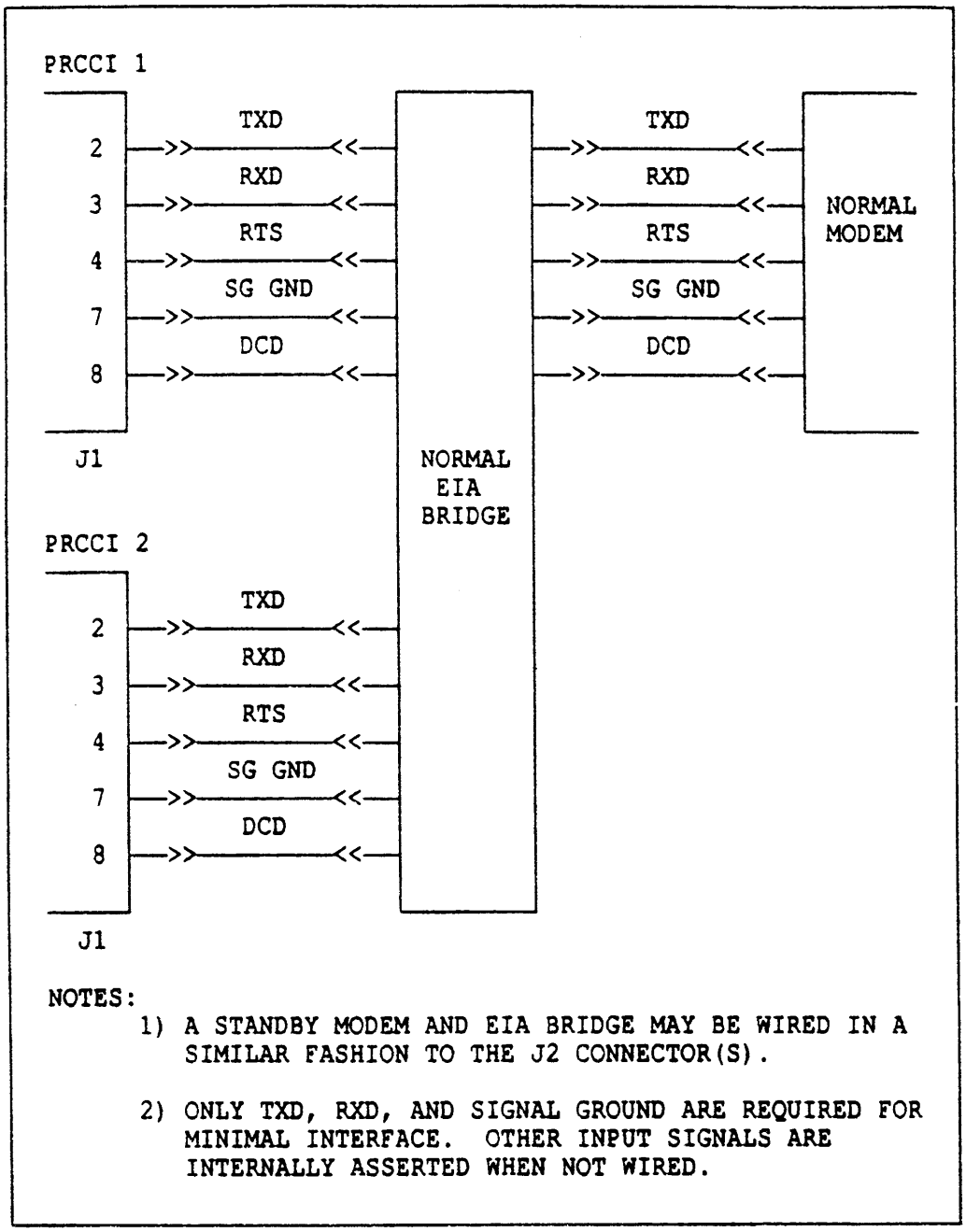


Figure 2-16. Remote Installation Using Multiple PRCCI Units

2.5 CODE LINE INTERFACE

The interface to the code line communication equipment is provided at connector J3 (FIELD COMM), located at the rear of the unit. It may be configured as either an RS-232C level or a current loop interface, depending upon the type of communication equipment used at the installation.

The RS-232C level interface is recommended and should be used in all installations whenever possible. It is, by far, the most common carrier interface and allows a wide variety of data monitoring equipment to be used on the communication circuit. Figure 2-15 provides specifications for this interface. Figure 2-18 shows a typical EIA level interface between a GENISYS PRCCI and carrier equipment.

Where only TTL level carrier is available, the current loop option provides a suitable interface but is not necessarily compatible with most communication test equipment. Figure 2-19 shows a typical TTL level interface between a GENISYS PRCCI and carrier equipment. Additional interfacing information is provided in the Hardware Description and Installation service manual.

The word format utilized on this channel is DIP switch selectable with 1 start bit, 8 data bits, an optional parity bit, and an option for 1 or 2 stop bits. The baud rate is also DIP switch selectable. Both the normal and alternate rates are determined by the switch selection.

The transmission of a character requires that the circuit transition from an idle MARK state to the SPACE state for one bit time. This first transition is called the start bit. During the next eight bit times, the circuit transitions between MARK and SPACE, as required, to represent the character. The least significant bit of the character is transmitted first. If enabled, the parity bit is transmitted next. Parity is an error detection mechanism where either an even or odd number of MARK bits are required within a character. The state of the parity bit is determined by the type of parity selected and the number of preceding data bits transmitted as a MARK. For even parity, the parity bit is manipulated to result in an even number of MARK bits. Odd parity results in an odd number of MARK bits to occur. A character is terminated with one or more stop bits. Stop bits force the circuit to the idle MARK state and serve to frame the transmitted character to ensure that the next start bit may be recognized as a MARK to SPACE transition. Figure 2-17 depicts the asynchronous character format utilized on the circuit.

2.6 LOCAL CONTROLS AND INDICATIONS

All of the line/local outputs and inputs are available to the office as local controls and indications. The use of these is dictated by installation requirements and should be reflected in site specific plans. Detailed information and specifications of the line/local interface are available in the Hardware Description and Installation service manual.

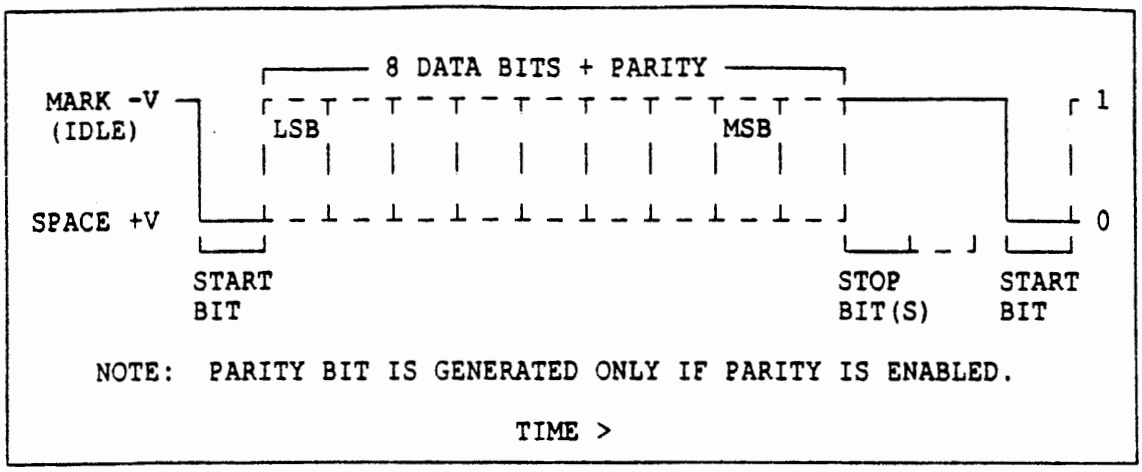


Figure 2-17. Asynchronous Character Format (Field)

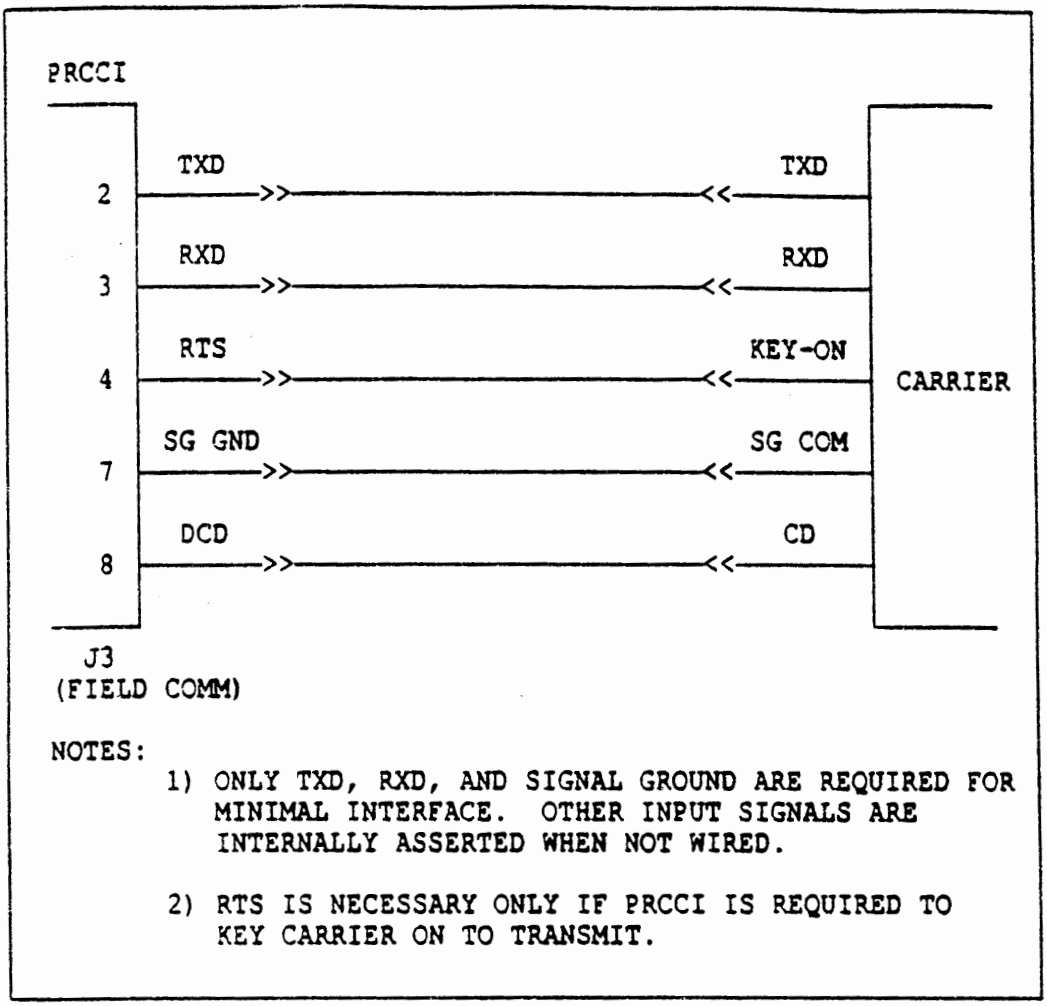
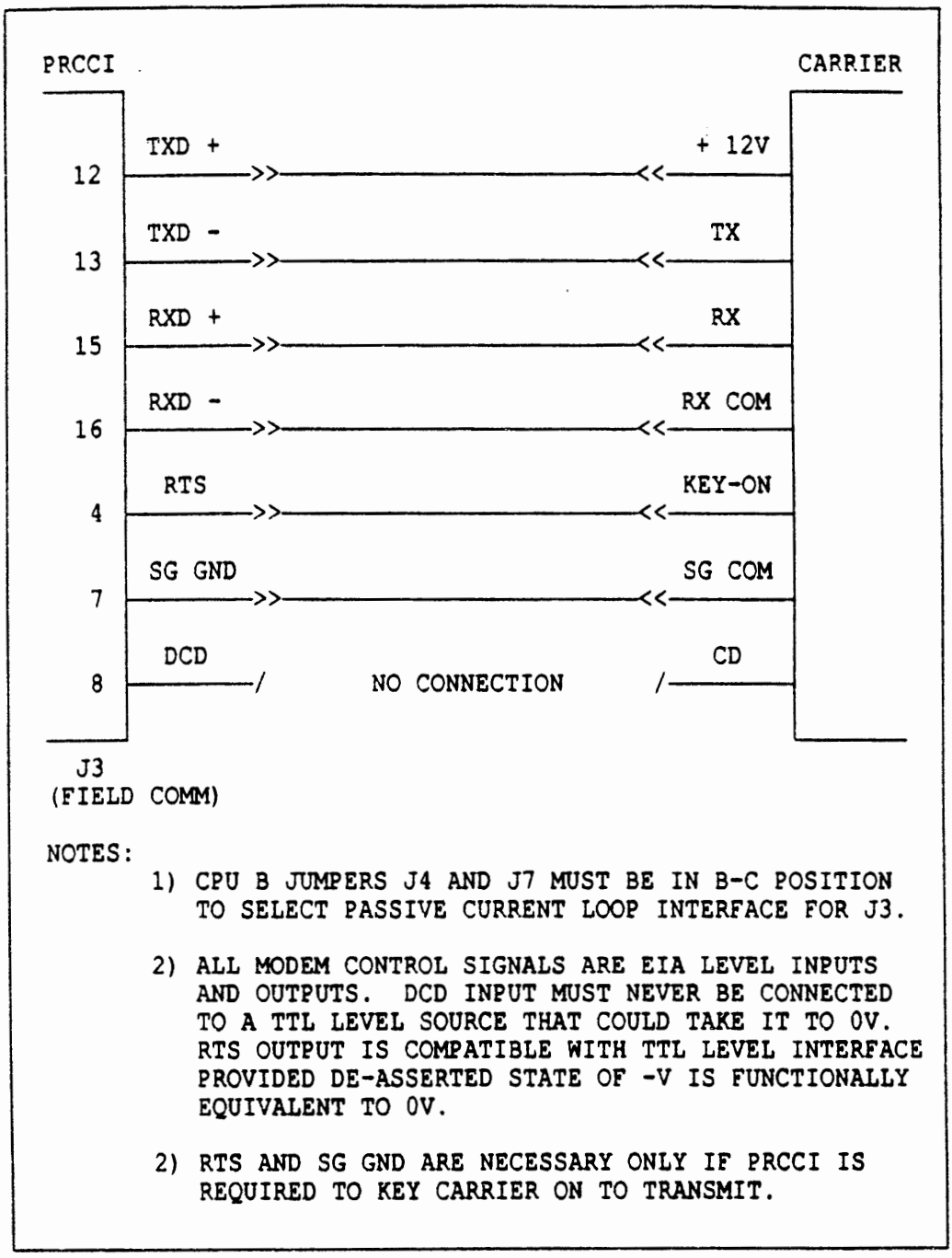


Figure 2-18. Typical EIA level Carrier Interface



NOTES:

1) CPU B JUMPERS J4 AND J7 MUST BE IN B-C POSITION TO SELECT PASSIVE CURRENT LOOP INTERFACE FOR J3.

2) ALL MODEM CONTROL SIGNALS ARE EIA LEVEL INPUTS AND OUTPUTS. DCD INPUT MUST NEVER BE CONNECTED TO A TTL LEVEL SOURCE THAT COULD TAKE IT TO 0V. RTS OUTPUT IS COMPATIBLE WITH TTL LEVEL INTERFACE PROVIDED DE-ASSERTED STATE OF -V IS FUNCTIONALLY EQUIVALENT TO 0V.

2) RTS AND SG GND ARE NECESSARY ONLY IF PRCCI IS REQUIRED TO KEY CARRIER ON TO TRANSMIT.

Figure 2-19. Typical TTL Level Carrier Interface

SECTION III

OPERATION

3.1 OVERVIEW

When power is first applied or the master reset switch is pressed, each cpu board independently executes self-tests to verify the integrity of the EPROM set and RAM. Following successful completion of these tests, the DIP switches are read, the message EMULATE GENISYS is displayed on the front panel, and the PRCCI waits for the office to establish communication.

In the event that one of the self-tests fail, the watchdog timer is allowed to trip and reset the cpu board. This is indicated by LED1 flashing on the failed cpu board. Should an error message be displayed, refer to section 3.6 for corrective action.

Briefly, the office should initialize the PRCCI and configure it to the installation. The office then requests indications from all stations on the code line through a sequence of individual recall requests. When there are no pending control or recall requests to transmit the PRCCI independently polls the field code units in a round robin fashion. This is indicated by only a station address displayed on the front panel.

3.2 FUNCTION LED DESCRIPTIONS

Seven of the eight LEDs in this group are software controlled status indicators for various functions under software control of the PRCCI. The remaining LED is a hardware driven power indicator. A brief description of each LED and its associated function is given below.

FUNCTION XMT

> This LED denotes a FIELD TRANSMIT function. When illuminated it indicates that the PRCCI is transmitting data to the field communication equipment.

FUNCTION REC

> This LED denotes a FIELD RECEIVE function. When illuminated, it indicates that the PRCCI is receiving data from the field communication equipment.

FUNCTION GM

This LED denotes a GOOD MESSAGE function. It reflects message traffic between the cpu boards. A flash rate of once per second indicates normal internal polling of CPU B by CPU A. A faster rate indicates message traffic between the PRCCI and the office.

FUNCTION ERR

This LED denotes a HOST ERROR function. When illuminated, it indicates that an error has been detected in communication with the office. It remains illuminated until communication is re-established with the office.

FUNCTION A

This LED denotes an ADDRESS ACCEPT function. When illuminated, it indicates that the PRCCI is being addressed by the office.

FUNCTION B

This LED denotes a STANDBY PORT ACTIVE function. When illuminated, it indicates that the office is communicating with the PRCCI over the standby channel.

FUNCTION C

This LED denotes a MAINTENANCE SESSION ACTIVE function. When illuminated, it indicates that a maintenance session is opened.

FUNCTION D

This LED is a hardware indication of the 5 volt output from the PRCCI power supply and should be illuminated constantly.

3.3 OUTPUT LED DESCRIPTIONS

The LEDs in this group are state indicators for each of the local control outputs. While the outputs themselves are under software control, these LEDs reflect the actual hardware state of the output module control circuits. They should normally remain dark and flash only when the associated local control is delivered.

3.4 INPUT LED DESCRIPTIONS

The LEDs in this group are hardware driven state indicators for each of the local indication inputs. When illuminated, they indicate that energy is applied to the associated input.

3.5 OPERATIONAL MESSAGES

EMULATE GENISYS

This message is displayed upon power-up, reset, and initialization from the office computer system. Following initialization, this message is normally replaced with other operational messages or station addresses are displayed as the polling cycle progresses.

CONTROL NN

This message indicates that the PRCCI is transmitting a control to station address NN. The message is displayed during the control transmission and any checkback, and execute sequence supported by the GENISYS code system.

RECALL NN

This message indicates that the PRCCI is recalling indications from station address NN.

KEY MARK

This message indicates that the PRCCI is in line maintenance mode, transmitting a rest state of MARK to the code line communication equipment. This capability is only provided through the maintenance session.

KEY SPACE

This message indicates that the PRCCI is in line maintenance mode, transmitting an inverted rest state (norest) of SPACE to the code line communication equipment. This capability is only provided through the maintenance session.

KEY DUTY CYCLE

This message indicates that the PRCCI is in line maintenance mode, transmitting a 50% duty cycle to the code line communication equipment. This capability is only provided through the maintenance session.

CODE LINE NORMAL

This message indicates that line maintenance mode has just been turned off and that normal code line operation has not yet resumed. There is typically a short delay in returning to normal operation that varies with the code line baud rate. This message will remain on the front panel if the PRCCI is not initialized.

3.6 ERROR MESSAGES

E

This error flag may appear on the front panel immediately to the right of the station address. It indicates that an error condition has been declared for the station due to a hardware level error detected in the last response from the station. Hardware level errors include parity, framing, or overrun (loss of data) errors.

A limited number of these errors over a period of time is to be expected and does not necessarily indicate improper operation of the code line. Should the number of these errors reach an unacceptable level, it should be considered an indication of poor line quality, communication equipment failure, or field unit failure.

M

This error flag may appear on the front panel immediately to the right of the station address. It indicates that a monitor condition has been declared for the station due to repeated protocol or hardware level errors. Protocol level errors include an illegal message header, illegal CRC-16, illegal message length, illegal station address, illegal responses, control checkback errors, and no response timeouts.

A limited number of these errors over a period of time is to be expected and does not necessarily indicate improper operation of the code line. Should the number of these errors reach an unacceptable level, it should be considered an indication of poor line quality, communication equipment failure, or field unit failure.

F

This error flag may appear on the front panel immediately to the right of the station address. It indicates that a failed condition has been declared for the station due to repeated protocol or hardware level errors. This condition indicates either a failure of the communication circuit or equipment or a failure of the field unit.

CONTROL ERR

This message indicates that an improperly formatted control request has been received from the office. Normally this reflects a possible problem in the office and should never occur with an in-service installation.

RECALL ERR

This message indicates that an improperly formatted recall request has been received from the office. Normally this reflects a possible problem in the office and should never occur with an in-service installation.

ADDRESS ERR

This message indicates that an illegal station address was specified in either an control or recall request from the office. The requested station address is not permitted to be zero or to exceed the highest address polled. This may reflect a possible problem in the office and should never occur with an in-service installation.

INVALID INIT MSG

An incorrect initialization message was received from the office. The message passed communication hardware checks and protocol level checks, but the contents of the message do not meet the requirements of the GENISYS application. Once the PRCCI receives an invalid initialization message, it ceases normal code line operation and requests initialization from the office.

This may reflect a possible problem in the office or that the PRCCI is not connected to the office through the correct communication channel. This error should never occur with an in-service installation.

NO CODE TYPE

No code type has been programmed into DIP switch SW7 on CPU B. The PRCCI allows the watchdog timer to trip and reset CPU B until the condition is corrected. Refer to Section 2.3 (CPU B Configuration) for programming information.

WRONG CODE TYPE

The wrong code system type has been programmed into DIP switch SW7 on CPU B. The PRCCI allows the watchdog timer to trip and reset CPU B until the condition is corrected. Refer to CPU B configuration section 1.4 for programming information.

INTERNAL ERR

This message indicates that CPU B detected errors in communication with CPU A. While a limited failure of communication hardware on CPU B could result in this error, the typical cause is a hardware or software failure of CPU A. This condition should never occur with an in-service installation.

SECTION IV

OFFICE INFORMATION EXCHANGE

4.1 OVERVIEW

The scheme for communication with the office computer system is similar to that used on a half duplex code line circuit where the office is the master to one or more slave PRCCI units. The protocol is designed to complement that used by the Union Switch & Signal GENISYS Non-vital Logic Emulator. This permits multiple PRCCI and GENISYS units to co-exist on the same communication circuit. Any GENISYS units must appear as slaved field code units.

All conversations on this circuit are initiated by the office and only the addressed unit is permitted to respond. If the unit detects an error in decoding a message, the error is implied by the lack of a response. The office attempts a limited number of retries on messages when no response is seen or an error is detected in the response.

4.2 PHILOSOPHY AND SECURITY

The protocol uses modified binary characters to frame messages that are designed to lend themselves to hexadecimal interpretation. Characters in the range of $F0 through $FE are reserved as unique control characters. The character $FF is illegal since it is commonly created on noisy data channels. Data security is provided in the form of a CRC-16 checksum. The generator polynomial is the standard CRC-16 polynomial:

$$X^{16} + X^{15} + X^2 + 1$$

Characters in the range of $00 to $EF are sent as is, in a single byte. A character in the range of $F0 through $FF is sent as a sequence of two bytes. This sequence consists of the data escape character $F0 followed by the low order nibble (right hex digit) of the original character. The receiver of any message containing this sequence must always logically OR the two characters and treat the result as a single character.

Every message starts with a function specific header character (in the range of $F1 through $F5 or $F7 through $FE) followed by a unit address. Any data, if applicable to the function, then follows. The data portion is function specific and may vary in length. Following the data is the CRC-16 then a $F6 terminator character (End-of-Text or ETX). The CRC-16 is generated from the header, address, and data portion prior to any possible data escape sequences being introduced. Only the message

header and terminator characters are excluded from any possible data escape sequence.

In general, messages are classified according to function with a unique header character for each class. Certain classifications employ auxiliary header characters appearing after the address. These denote specific functions within a classification which contains multiple messages. Figure 4-1 summarizes, by classification, the messages sent by the office to the PRCCI. Figure 4-2 summarizes those sent by the PRCCI to the office.

MSG HDR	AUX HDR	FUNCTION
F7	A0	PRCCI INITIALIZATION
	A1	INDICATION DATABASE REQUEST
	A4	STATUS INDICATION REGISTER REQUEST
	A5	SET STATUS CONTROL REGISTER
F8	A6	RESERVED
	A7	
	A8	
	A9	
	AA	
	AB	
	AC	CONTROL REQUEST
	AD	INDICATION RECALL
	AE	EXECUTE CONTROL
	AF	RESERVED
F9	--	RESERVED
FA	--	ACKNOWLEDGE AND POLL
FB	--	POLL
FC	--	LOCAL CONTROL REQUEST
FD	--	LOCAL INDICATION RECALL
FE	--	EXECUTE LOCAL CONTROL

Figure 4-1. Office Generated Messages

MSG HDR	AUX HDR	FUNCTION
F1	--	ACKNOWLEDGE
F2	--	LOCAL INDICATION
F3	--	LOCAL CONTROL CHECKBACK
F4	--	STATUS INDICATION REGISTER DATA
F5	A2	INDICATION
	A3	CONTROL CHECKBACK

Figure 4-2. PRCCI Generated Messages.

4.3 OFFICE GENERATED MESSAGES

This section discusses the function and implementation of messages exchanged between an office computer system and a GENISYS PRCCI. The possible responses are given for messages generated by an office. These are listed in order from the highest priority to the lowest.

Each message must pass a variety of hardware and protocol level checks before it may be processed. The lower level hardware checks verify the line integrity, character framing, and that no data overrun has occured (loss of data). A series of protocol checks progressively verify any CRC-16, the message header, unit address, and any auxiliary header. Each message is then subject to specific edit checks to verify that the contents meet the requirements of the application and the installation.

4.3.1 Poll

The poll message is generated to allow the PRCCI to return any new or changed information from its database. This message has both a secure and non-secure format. The secure format contains a CRC-16 while the non-secure does not. The format used is determined by the SENSEC flag in Status Control Register 1. Valid responses from the PRCCI include:

1. SIR data
2. Indication
3. Local indication
4. Acknowledge (ACK)

4.3.2 Acknowledge And Poll

The acknowledge and poll message is generated to acknowledge data from the PRCCI and to poll for any additional information. All messages from the PRCCI that contain data must be acknowledged by the office. Until acknowledged, the PRCCI assumes the office failed to receive the last

response, and will re-transmit it in subsequent conversations. In subsequent conversations a higher priority response may take precedence but no loss of data occurs.

4.3.3 PRCCI Initialization

The PRCCI initialization message is the primary mechanism used by the office to configure a PRCCI to a specific installation. The capabilities of a PRCCI are limited until the unit is initialized by the office. This message supplies the unit with parameters to be used in communication with both the office and field. These parameters are described in the following sections. Valid responses from the PRCCI include:

1. SIR data
2. Acknowledge (ACK)

4.3.3.1 Maximum Indication Records Per Message

This parameter determines the maximum number of buffered indication records that may be returned to the office in a single indication message. A record represents a single indication message from a field code unit. Adjustment of this parameter not only affects operation of the PRCCI but may also affect the perceived performance of the office.

This parameter must be set between 1 and 8. In general, the slower the effective rate at which the PRCCI is polled the higher this parameter should be. A single unit connected directly to the office through a dedicated channel may have this parameter set relatively low (1 or 2). Multiple units that share a communication channel to the office should have this parameter set higher to compensate for the effectively slower polling rate.

4.3.3.2 Maximum Control Queue Entries

This parameter determines the maximum number of control and recall requests that may be buffered by the PRCCI at any one time. Normally the office is capable of generating such requests at a faster rate than which the PRCCI is able to transmit them to the the field. This parameter must be set between 1 and 8.

4.3.3.3 Maximum Station Address

This parameter determines the highest station address polled by the PRCCI. The PRCCI also uses this parameter to verify the station address in control and recall requests from the office. The GENISYS PRCCI application restricts the highest station address to 127.

4.3.3.4 Number Of Station Retries Per Set

This parameter determines the number of single retries in a retry set. Primarily, it dictates the number of times that the PRCCI may retry a transmission before declaring an error monitor condition for a field

code unit. This parameter must be set between 1 and 5

4.3.3.5 Number Of Station Retry Sets

This parameter determines the number of retry sets that the PRCCI must exhaust before declaring a failure condition for a field code unit. It must be set between 1 and 5.

4.3.3.6 Maximum Control Byte Number

This parameter determines the highest control byte number that may be specified in a control request from the office. The GENISYS PRCCI application restricts each field code unit to a maximum of 32 control bytes and assumes that those bytes are addressed as 0 through 31. The GENISYS E0 control byte, processed internally by the PRCCI, is not subject to this restriction.

4.3.3.7 Maximum Indication Byte Number

This parameter determines the highest indication byte number that may be received from a field code unit and as well as returned to the office. The GENISYS PRCCI application restricts each field code unit to a maximum of 32 indication bytes and assumes that those byte are addressed as 0 through 31. Regardless of the selection for this parameter, the GENISYS E0 indication byte is accepted in a field indication message and is also passed in an office indication message.

4.3.3.8 E0 Control Byte Mask

This parameter instructs the PRCCI how to configure the E0 control byte of each field code unit. The use of the E0 byte is explained in more detail section 5.6.

4.3.4 Set Status Control Register

The set status control register (SCR) message is a secondary mechanism used by the office to initialize, dynamically alter, or otherwise maintain certain operating characteristics. The characteristics determined by the status control registers may be altered without re-initialization of the PRCCI. Section 4.5 describes the registers and the characteristics that they control. Valid responses from the PRCCI include:

1. SIR data
2. Indication
3. Local indication
4. Acknowledge (ACK)

4.3.5 Status Indication Register Request

The status indication register (SIR) request message is generated to examine the current contents of all such registers defined by the GENISYS PRCCI application. Valid responses from the PRCCI include:

1. SIR data
2. Acknowledge (ACK)

4.3.6 Indication Database Request

The indication database request message is generated by the office to update its own indication database. This function provides the capability for the office to update itself without having to place recall and unchanged indication traffic on the field code line. Indication data generated in response to this request appears to the office as normal indication messages. Valid responses from the PRCCI include:

1. SIR data
2. Indication
3. Local indication
4. Acknowledge (ACK)

4.3.7 Local Control Request

The local control request message is generated to request that the PRCCI deliver local controls. If control checkback is enabled the only legal response is a local control checkback message. When checkback is disabled, valid responses from the PRCCI include:

1. SIR data
2. Indication
3. Local indication
4. Acknowledge (ACK)

4.3.8 Execute Local Control

The execute local control message is generated to execute a local control request that had been previously verified with a local control checkback message from the PRCCI. This message must immediately follow the local control checkback or the office must repeat the sequence beginning with a retry of the local control request. This message is illegal if control checkback is disabled. Valid responses from the PRCCI include:

1. SIR data
2. Acknowledge (ACK)

4.3.9 Local Indication Recall

The local indication recall message is generated to request the current local indications from the PRCCI. The PRCCI is only permitted to respond with:

1. SIR data
2. Local indication

4.3.10 Control Request

The control request message is generated to request that the PRCCI transmit a control message to the field. This message specifies the field code unit address, the number of control bytes in the request, as well as each control byte number and current control byte data. If control checkback is enabled the only legal response is a control checkback message. When checkback is disabled, valid responses from the PRCCI include:

1. SIR data
2. Indication
3. Local indication
4. Acknowledge (ACK)

4.3.11 Execute Control

The execute control message is generated to execute a control request that had been previously verified with a checkback message from the PRCCI. This message must immediately follow the control checkback or the office must repeat the sequence beginning with a retry of the control request. This message is illegal if control checkback is disabled. Valid responses from the PRCCI include:

1. SIR data
2. Acknowledge (ACK)

4.3.12 Indication Recall

The indication recall message is generated to request that the PRCCI recall current indications from the specified field code unit. The indications received by the PRCCI in response to the recall are always returned to the office regardless of whether or not there is a change in state. Valid responses from the PRCCI include:

1. SIR data
2. Indication
3. Local indication
4. Acknowledge (ACK)

4.4 PRCCI GENERATED MESSAGES

4.4.1 Local Control Checkback

The local control checkback message is generated as part of the verification procedure for local control delivery. It is only legal in response to a local control request from the office when checkback is enabled. A proper checkback response returns the same control byte number and control byte data as requested.

4.4.2 Control Checkback

The control checkback message is generated as part of the verification procedure for control transmission to the field. It is only legal in response to a control request from the office when checkback is enabled. A proper checkback response returns the same field code unit address, and control information as requested.

4.4.3 Status Indication Register Data

The SIR data message is generated to return SIR information to the office. SIR information is returned only when changes occur or upon request from the office.

4.4.4 Indication

The indication message is generated to return field indication data to the office. Normally, indications are returned only when a change in state is detected or when the office has requested a recall. This message may contain multiple indication records where each record is associated with a particular field code unit. The PRCCI initialization message specifies the maximum number of records that may appear in a message. An indication record specifies the field code unit address, the number of indication bytes in the record, as well as each indication byte number and current indication byte data.

The indication message is also used to report field code unit status information to the office. Such information includes monitor and failure conditions that may be declared or automatically cleared up by the PRCCI.

4.4.5 Local Indication

The local indication messsage is generated to return local indication data to the office. Local indications are returned only when a change in state is detected or in response to a recall from the office.

4.4.6 Acknowledge

The acknowledge message is generated as a response when the PRCCI has no data to return to the office. This message has only a non-secure format that does not contain a CRC-16.

4.5 STATUS CONTROL AND INDICATION REGISTERS

Certain operating characteristics are controlled and indicated through internal status registers. These registers are accessible by the office computer system and allow the office to dynamically maintain the characteristics as well as sense and/or clear possible error conditions detected by the PRCCI.

There are sixteen registers available; addressed 0 through 15. While the function of each register is consistent across all PRCCI applications, not all registers are used by all of the applications. This section describes each register implemented by the GENISYS PRCCI application. Those not described are accessible but perform no function.

4.5.1 Status Control Register 0

SNOIDB			SCTBSY	SINQOV	SDETER	SLNERR	

Figure 3-3. SCR 0 Flags

SNOIDB - Clear the no indication database flag

SCTBSY - Clear control queue busy flag. Forces the PRCCI to clear its control request queue.

SINQOV - Clear indication queue overflow flag. The indication queue is not cleared of data.

SDETER - Clear PRCCI detected error flag.

4.5.2 Status Indication Register 0

SNOIDB	SMAINT	SCTERR	SCTBSY	SINQOV	SDETER	SLNERR	SRCINI

Figure 3-4. SIR 0 Flags

SNOIDB - No indication database. This flag is cleared by the office to signify that indications from all stations on the code line have been received. The PRCCI normally sets this flag upon reset or initialization.

SMAINT - Maintenance session open. This flag is set to indicate that a maintenance session is opened.

SCTERR - Control request error. This flag is set to indicate that an error was detected while performing edit checks on a previous control request from the office. It remains set until the office generates an acceptable control request.

SCTBSY - Control queue busy. This flag is set to indicate that the maximum number of control requests have been queued by the office. The flag is cleared automatically once the control queue is sufficiently emptied to accept additional requests.

SINQOV - Indication queue overflow. This flag is set to signify that the field indication queue has overflowed. Previous indication data is lost since the queue is automatically cleared and the

most recent indication is inserted. The flag is cleared on reset, initialization, or by request of the office.

SDETER - PRCCI detected error. Reserved flag.

SLNERR - Code line error. This flag is set to indicate that an error was detected on the code line. This flag is automatically cleared once communication is re-established on the code line.

SRCINI - PRCCI initialization request. This flag is set to request initialization from the office. It may only ever be cleared by the office with a valid initialization message.

4.5.3 Status Control/Indication Register 1

	SFLTRI	SENCOD	SENSEC	SENCBC	SALNRT	SATPAR	SRBADI

Figure 3-5. SCR/SIR 1 Flags

SFLTRI - Enable indication change filter. This flag is set to filter only changed indications to the office. If cleared, all indications, as received, are passed to the office. It is set on reset and initialization.

SENCOD - Enable code line communication. This flag is primarily intended for use on polling code systems. Only when this flag is set is the PRCCI permitted to communicate with the fields. It is cleared on reset, initialization, and during certain maintenance functions.

SENSEC - Enable secure poll. This flag is set to force the PRCCI to accept only secure poll messages from the office. If this flag is cleared, the PRCCI will accept either secure or non-secure polls. It is cleared on reset and initialization.

SENCBC - Enable control checkback. This flag is set to enable control checkback mode for all control and local control requests from the office. It is cleared on reset and initialization.

SALNRT - Enable alternate line rate. This flag is set to instruct the PRCCI to use the alternate line rate for field communication. It is normally cleared on reset and initialization to default to the normal line rate. The normal line rate is specified in SCR/SIR 3 while the alternate is specified in SCR/SIR 4.

SATPAR - Enable alternate timing parameters. Reserved flag.

SRBADI - Return bad indications. Reserved flag.

4.5.4 Status Control/Indication Register 2

Reserved for future use.

4.5.5 Status Control/Indication Register 3

These registers typically select and indicate the normal baud rate for field communication. The GENISYS PRCCI application does not permit the office to alter this DIP switch selected parameter.

4.5.6 Status Control/Indication Register 4

These registers typically select and indicate the alternate baud rate for field communication. The GENISYS PRCCI application assigns the alternate rate to be the same as the DIP switch selected normal rate. As with the normal rate, the office is not permitted to alter this parameter.

SECTION V

FIELD INFORMATION EXCHANGE

5.1 OVERVIEW

The PRCCI communicates with one or more GENISYS field code units over a half duplex code line. The PRCCI is the master on this circuit and initiates all conversations. Only the addressed field unit is permitted to respond. If the unit detects an error in decoding a transmission, the error is implied by the lack of a response. The PRCCI attempts a limited number of retries on messages when no response is seen or an error is detected in the response.

5.2 PHILOSOPHY AND SECURITY

The protocol uses modified binary characters to frame messages that are designed to lend themselves to hexadecimal interpretation. Characters in the range of $F0 through $FE are reserved as unique control characters. The character $FF is illegal since it is commonly created on noisy data channels. Data security is provided in the form of a CRC-16 checksum. The generator polynomial is the standard CRC-16 polynomial:

$$X^{16} + X^{15} + X^2 + 1$$

Characters in the range of $00 to $EF are sent as is, in a single byte. A character in the range of $F0 through $FF is sent as a sequence of two bytes. This sequence consists of the data escape character $F0 followed by the low order nibble (right hex digit) of the original character. The receiver of any message containing this sequence must always logically OR the two characters and treat the result as a single character.

Every message starts with a function specific header character (in the range of $F1 through $F3 or $FA through $FE) followed by a unit address. Any data, if applicable to the function, then follows. The data portion is function specific and may vary in length. Following the data is the CRC-16 then a $F6 terminator character (End-of-Text or ETX). The CRC-16 is generated from the header, address, and data portion prior to any possible data escape sequences being introduced. Only the message header and terminator characters are excluded from any possible data escape sequence.

In general, messages are classified according to function with a unique header character for each class. Figure 5-1 summarizes the message headers used by the PRCCI in transmissions to GENISYS field code units. Figure 5-2 summarizes those used by GENISYS units to respond to PRCCI transmissions.

HEADER	MESSAGE FUNCTION
F7	RESERVED
F8	
F9	
FA	ACKNOWLEDGE AND POLL
FB	POLL
FC	CONTROL REQUEST
FD	INDICATION RECALL
FE	EXECUTE CONTROL

Figure 5-1. PRCCI Generated Messages

HEADER	MESSAGE FUNCTION
F1	ACKNOWLEDGE
F2	INDICATION
F3	CONTROL CHECKBACK

Figure 5-2. GENISYS Generated Messages.

5.3 PRCCI GENERATED MESSAGES

This section discusses the function and implementation of messages exchanged between a GENISYS PRCCI and a GENISYS field code unit. Each message must pass a variety of hardware and protocol level checks before it may be processed. The lower level hardware checks verify the line integrity, character framing, and that no data overrun has occured (loss of data). The protocol level checks progressively verify any CRC-16, the message header, unit address, and any data portion of each message.

5.3.1 Poll

The poll message is generated to allow a GENISYS to return any new or changed indication information. This message has both a secure and non-secure format. The secure format contains a CRC-16 while the non-secure does not. The format used is determined by the secure poll flag in the E0 control byte. Either an indication or acknowledge is a valid response to this message.

5.3.2 Acknowledge And Poll

The acknowledge and poll message is generated to acknowledge an indication from a GENISYS and to poll for any additional information. All indication messages from a GENISYS must be acknowledged by the PRCCI. Until acknowledged, the unit assumes the PRCCI failed to receive the last response, and will re-transmit it in subsequent conversations. As with a poll message, either an indication or acknowledge is a valid response to this message.

5.3.3 Indication Recall

The indication recall message is generated to request all current indications from a GENISYS. The GENISYS is only permitted to respond with an indication message.

5.3.4 Control Request

The control request message is generated to request that a GENISYS deliver the specified control data. The PRCCI is only capable of transmitting a control message upon request from the office and does not attempt to filter changes in control data. It transmits all control data requested by the office, regardless of whether or not there is actually a change of state. Under normal circumstances, only the control data specified in a control request is transmitted. The exception to this is when the PRCCI detects that a station's control database is incomplete. When this occurs, the PRCCI waits for the next office control to that station and proceeds to transmit all valid control bytes regardless of whether or not all were requested. If control checkback is enabled the only legal response is a control checkback message. When checkback is disabled either an indication or acknowledge is a valid response to this message.

5.3.5 Execute Control

The execute control message is generated to request that a GENISYS execute a control request that had been previously verified with a checkback message from the unit. This message must immediately follow the control checkback or the PRCCI must repeat the sequence beginning with a retry of the control request. This message is illegal if control checkback is disabled. Either an indication or acknowledge is a valid response to this message.

5.4 GENISYS GENERATED MESSAGES

5.4.1 Control Checkback

The control checkback message is generated as part of the verification procedure for control delivery. It is only legal in response to a control request from the PRCCI when checkback is enabled. A proper checkback response returns the byte number and data for each control byte requested.

5.4.2 Indication

The indication messsage is generated to return indication data to the PRCCI. Indications are normally returned only when a change in state is detected or in response to a recall from the PRCCI. Excluding the E0 indication byte, an indication message may not contain an indication byte number that exceeds the maximum specified by the office at initializatic

5.4.3 Acknowledge

The acknowledge message is generated as a response when a GENISYS has no data to return to the PRCCI. This message has only a non-secure format that does not contain a CRC-16.

5.5 POLLING CYCLE DESCRIPTION

The PRCCI polls a pre-determined number of stations in a round robin fashion. To minimize delays in the polling cycle, due to errors or no response timeouts, failed stations are not polled. At the end of each polling cycle a recall is transmitted for a failed station in an attempt to eventually establish communication with all possible stations. Office requests for controls recalls take priority and may interrupt the normal polling cycle. When all office requests are satisfied the polling resumes from the point at which it was interrupted.

Any time that either a hardware or protocol level error is detected for a live station the PRCCI skips to the next live station in the polling cycle. It then retries the transmission the next time that station is to be polled. A station error, or monitor condition, is reported to the office only after a complete retry set has been performed. A station failure is reported to the office only after a pre-determined number of retry sets have been exhausted.

5.6 E0 BYTE DESCRIPTION

The E0 byte provides for the control and indication of certain optional features including the use of secure polling and control checkback. Power-on or reset of a GENISYS unit is detected through the use of the database complete flag. That flag represents the current state of the unit's control database. The E0 byte flags are shown in figure 5-3.

The PRCCI automatically monitors the E0 indication byte and maintains the E0 control byte for each station. Except for the database complete flag, the flags to be set in the E0 control byte are determined by the office at initialization time. The office is not expected to specify an E0 control byte within a control request. The PRCCI assumes however, that any E0 indication byte returned from a GENISYS unit has changed and passes it to the office. This allows the office to also detect power-on or reset of a GENISYS unit.

The PRCCI determines if the transmission of an E0 control byte is required and relies on the next office control request for the station to determine when the transmission is permitted. An E0 control byte transmission is required if either the database complete flag is de-asserted or the state of any other flags in the byte do not match the office specified states.

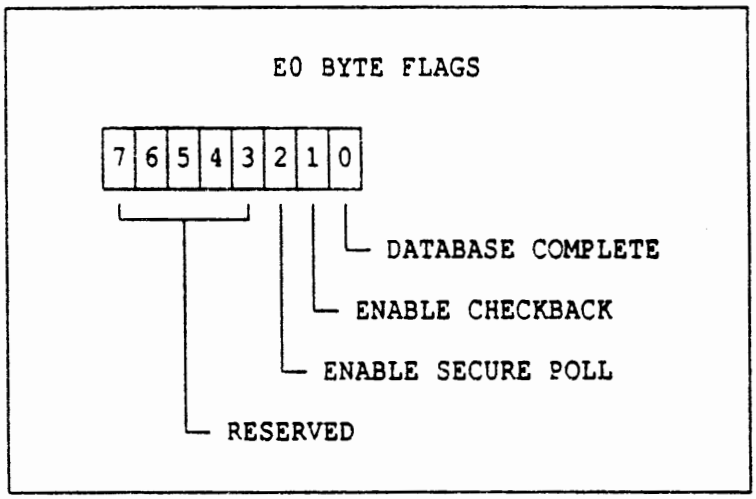


Figure 5-3. E0 Byte Flags

SECTION VI

MAINTENANCE SESSION

6.1 OVERVIEW

The maintenance session provides the capability, through an ANSI standard terminal, to monitor message traffic and performance of both the office communication channel and field code line. Interactive diagnostic tools allow the user to locally generate a limited number of code line messages, review various reports, as well as examine or temporarily alter certain operating characteristics. Access is restricted by two protection mechanisms. The address of the unit and a password must be properly specified in order to open a session. All units employ the same password which may not be altered.

A maintenance command consists of one or more words possibly followed, depending upon the command, by one or more numeric values. Only one command may be entered on a line and each line must be terminated with a carriage return. Numeric values may typically be entered in decimal, hexadecimal, binary, or the native language of the coding equipment. In general, the format is selectable by the user but restrictions do apply to certain commands. These restrictions are noted in the respective command descriptions.

Prior to entering the carriage return at the end of a command line, characters on the line may be corrected through the use of the delete (RUBOUT) or backspace key. The delete causes the character immediately to the left of cursor to be ignored by the PRCCI. The resulting display is determined by the SET CRT command. A partially entered command line may timeout and be ignored by the PRCCI after approximately twenty (20) seconds of inactivity.

The maintenance session recognizes control-Q and control-S as XON/XOFF flow control characters. This provides a "hold screen" feature that is useful for reviewing reports that scroll off a CRT screen. Control-C is recognized as an interrupt character. It may be used to abort any command or report and return the user to the command line prompt. For compatibility with the office protocol, these features are only enabled while a session is opened.

6.2 NUMERIC CODE LINE INFORMATION

Decimal, hexadecimal, binary, and various native formats are available for the entry and display of numeric fields that represent code line address, control, and indication information. The native formats are

essentially binary except that specific alphabetic characters replace the usual "1" and "0". The formats are selected with the SET FORMAT command. Fields for numeric code line information are divided into groups of eight bits or 1 byte and may be represented by a value from 0 to 255 (decimal). Certain commands may further restrict the value of some fields, such as a station address. Control and indication information is displayed such that it corresponds, left to right, with a typical code and function assignment sheet.

The decimal format allows code line information to be represented with the digits 0 through 9. When entering fields, leading zeroes are typically permitted but ignored.

The hexadecimal format allows code line information to be represented with the digits 0 through 9 and A through F. In the specification and display of station addresses, leading zeroes are always significant. Some application independent commands use four hexdecimal digits to represent a station address. Within these fields, address information is left justified and interpreted left to right. Fields entered with fewer than four digits are padded on the right with zeroes.

The binary and native formats allow code line information to be represented with the digits 1 and 0 or two other appropriate characters. In the specification and display of station addresses, leading zeroes (or equivalent) are always significant. Some application independent commands use sixteen digits to represent a station address. Within these fields, address information is left justified and interpreted left to right. Fields entered with fewer than sixteen digits are padded on the right with zeroes (or equivalent).

6.3 OPENING A MAINTENANCE SESSION

A proper login and password sequence is necessary to open a maintenance session on any PRCCI. The LOGIN command must be spelled correctly and specify, in decimal, the address of the PRCCI. For compatibility with the office protocol, a PRCCI does not generate any responses or echo characters until a LOGIN command has been accepted. For this reason, no prompt is ever generated for a LOGIN command. Upon receipt of a proper LOGIN command the PRCCI prompts the user for a password. The password is not echoed and if it is entered incorrectly, the login sequence is aborted without any warning or error messages.

Once a maintenance session is opened, a brief welcome message and a command line prompt are displayed. Any legal maintenance command may now be entered. A HELP command is available that displays a summary of maintenance commands and their options. The HELP command accepts, as an option, a command name and provides detailed information on the command's syntax or format.

A maintenance session is normally closed with a LOGOUT command and a brief termination message is displayed. A valid office protocol message may override an open session. This forces the session closed immediately and no termination message is displayed.

In the example below, a maintenance session is opened on a PRCCI with an assigned address of two. Underscored text is entered by the user.

```
LOGIN 2
Password: ______
Maintenance session opened on PRCCI 2.
PRCCI> HELP

CLEAR option [arg1]

        ERRORS   HISTORY
 ...      ...      ...

PRCCI> HELP CLEAR

CLEAR option [arg1]

        ERRORS
        HISTORY [type]
                FIELD
                OFFICE
                TIME

PRCCI> LOGOUT
Maintenance session closed on PRCCI 2.
```

6.4 COMMAND DESCRIPTIONS

This section describes the syntax and use of the maintenance session commands. Any command element that appears in upper case is referred to as a key-word and is considered part of the command syntax. A key-word may be entered in either upper or lower case, using enough characters to make it unique from any other key-word allowed in the particular command line. Elements that appear in lower case indicate either that one of several key-words or a numeric argument is to be used in the command line. Key-words to be substituted in this manner are listed below the element in the syntax description. Elements enclosed in square brackets ([]) may be considered optional and need not be entered for the command to be accepted. These may include key-words or numeric arguments. All elements entered in a command line must be separated by at least one space.

6.4.1 CLEAR

Syntax:

```
CLEAR option [arg1]

      ERRORS
      HISTORY [type]

              FIELD
              OFFICE
              TIME
```

The CLEAR command purges specific report and historical information that is maintained by the PRCCI.

6.4.1.1 CLEAR ERRORS

Syntax:

```
CLEAR ERRORS
```

The CLEAR command entered with the ERRORS option zeroes the indication station error counters and the line error counter.

6.4.1.2 CLEAR HISTORY

Syntax:

```
CLEAR HISTORY [type]

              FIELD
              OFFICE
              TIME
```

The CLEAR command entered with HISTORY option causes historical information to be purged from the specified history queue. If no queue type is specified, all history queues are purged.

6.4.2 DISCONNECT

Syntax:

```
DISCONNECT
```

The DISCONNECT command typically performs a code line disconnect function. The GENISYS code system does not provide this capability and therefore this command has no function in this PRCCI application.

6.4.3 HELP

Syntax:

```
HELP [command]
```

The HELP command provides a summary of the syntax for all maintenance commands and their associated options. This command accepts, as an option, a command name and provides detailed help on that command's syntax. If the command name is abbreviated, help is provided on all commands that match.

6.4.4 HISTORY

Syntax:

HISTORY option

FIELD
OFFICE
TIME

The HISTORY command generates a historical report on various types of information exchanged through and obtained by the PRCCI. All historical information is stored in circular queues. In this type of storage structure, the oldest information stored is discarded as new information is inserted. These queues are continuously updated and function independently of any monitor or trace functions.

6.4.4.1 HISTORY FIELD

Syntax:

HISTORY FIELD

The HISTORY command entered with the FIELD option generates a historical report of the most recent field requests and indications exchanged between the PRCCI and the field code units. For each transmission reported, the message type is displayed followed by any applicable station address and control or indication data. Station addresses and data are always displayed in the currently selected format.

6.4.4.2 HISTORY OFFICE

Syntax:

HISTORY OFFICE

The HISTORY command entered with the OFFICE option generates a historical report of the most recent messages exchanged between the office computer system and the PRCCI. Direction and contents are reported for each historical message. Direction is indicated by the symbols XMT and RCV. XMT denotes a PRCCI transmission to the office while RCV denotes reception from the office. The message contents are always displayed in hexadecimal.

6.4.4.3 HISTORY TIME

Syntax:

HISTORY TIME

The HISTORY command entered with the TIME option performs no function in this PRCCI application.

6.4.5 LOGIN

Syntax:

```
LOGIN prcci_address
```

The LOGIN command is used to gain the attention of a specific PRCCI to open a maintenance session. The PRCCI address must be specified as a decimal value between 1 and 255. No prompt is generated for this command. Upon receipt of a proper LOGIN command, the PRCCI prompts the user for a password. The password is not echoed and if it is entered incorrectly, the login sequence is aborted without any warning or error messages.

If a LOGIN command is entered during an open maintenance session, the open session is automatically closed. This is to prevent multiple maintenance sessions on a channel.

6.4.6 LOGOUT

Syntax:

```
LOGOUT
```

The LOGOUT command closes the current maintenance session.

6.4.7 MONITOR

Syntax:

```
MONITOR option

        [NO]AUTOMATIC
        FIELD
        OFFICE
```

The MONITOR command allows either office or field message traffic to be monitored on the maintenance terminal. The maintenance session is essentially placed in a datascope mode while this function is active. Only control characters entered from the terminal keyboard are processed and echoed while the monitor function is active. Printable characters entered from the keyboard result in a warning bell. This feature allows carriage return (RETURN, ENTER, or control-M) and form-feed (control-L) characters to be entered to manipulate a printer carriage from the terminal keyboard. The monitor function is terminated with the control-C interrupt.

6.4.7.1 MONITOR AUTOMATIC

Syntax:

```
MONITOR AUTOMATIC

MONITOR NOAUTOMATIC
```

The MONITOR command entered with the AUTOMATIC or NOAUTOMATIC option selects whether or not the PRCCI may automatically activate the field monitor function when a RECALL command is entered by the user.

The selection of AUTOMATIC allows the PRCCI to automatically activate the field monitor function upon successful completion of a RECALL command. This feature requires that an indication or time message trace must be previously selected with the SET TRACE command. The monitor function operates in the normal fashion and may be terminated with the control-C interrupt.

The selection of NOAUTOMATIC inhibits the PRCCI from automatically activating the field monitor, regardless of any message traces selected.

6.4.7.2 MONITOR FIELD

Syntax:

MONITOR FIELD

The MONITOR command entered with the FIELD option specifies that field message traffic is to be monitored on the maintenance terminal. The types of messages to be monitored and any station address trace filter must be previously specified with the SET TRACE command. For each transmission reported, the message type is displayed followed by any applicable station address and control or indication data. Station addresses and data are always displayed in the currently selected format.

6.4.7.3 MONITOR OFFICE

Syntax:

MONITOR OFFICE

The MONITOR command entered with the OFFICE option specifies that office message traffic is to be monitored on the maintenance terminal. Only messages addressed to the PRCCI are monitored. Direction and contents are reported for each monitored message. Direction is indicated by the symbols XMT and RCV. XMT denotes a PRCCI transmission to the office while RCV denotes reception from the office. The message contents are always displayed in hexadecimal.

6.4.8 RECALL

Syntax:

RECALL option

ALL
control_address

The RECALL command allows the user to manually request a recall to be transmitted for a specific station.

The GENISYS code system does not provide a master recall capability and therefore the ALL option performs no function in this PRCCI application.

6.4.9 RESET

Syntax:

RESET

The RESET command typically causes a master reset function to be applied to the code line. The GENISYS code system does not support this capability and therefore this command performs no function in this PRCCI application.

6.4.10 SET

syntax:

```
SET option [arg1] [arg2]

    [NO]CRT
    FORMAT format_code
           BINARY
           DECIMAL
           HEXADECIMAL
           LS
           HL
           LH
           MS
           SM
    LINE state
         CYCLE
         NORMAL
         [NO]REST
    SCR scr_number mask
    SIR sir_number mask
    NOTRACE [arg1]
            CONTROL
            INDICATION
            TIME
    TRACE arg1 [arg2]
          CONTROL [control_address]
          INDICATION [indication_address]
          TIME [indication_address]
    TRIGGER station_number
```

The SET command allows the user to customize the maintenance session environment as well as review or modify various parameters and operating characteristics.

6.4.10.1 SET CRT

Syntax:

```
SET CRT

SET NOCRT
```

The SET command entered with either the CRT or NOCRT option selects whether the PRCCI treats the maintenance terminal as an ANSI standard CRT or a hardcopy terminal. This affects the display of the current line when a character is deleted.

The selection of CRT mode allows the delete (RUBOUT) or backspace key to erase a character from the terminal screen by echoing the sequence of backspace, space, backspace. The NOCRT mode causes the delete sequence to echo backslash, deleted character(s), backslash.

6.4.10 2 SET FORMAT

Syntax:

SET FORMAT format_code

BINARY
DECIMAL
HEXADECIMAL
LS
HL
LH
MS
SM

The SET command entered with the FORMAT option allows the user to specify the format used for entering and the display of numeric code line information. The two character key-words used to select the native formats are designed so that the left character represents a binary "1" while the right represents a "0".

Mark/space terminology is selected with the key-words MS or SM while high/low terminology is selected with HL or LH. Long/short terminology is selected with the key-word LS. For proper representation of control and indication data in a native format, the selection of either MS or HL is recommended.

6.4.10.3 SET LINE

Syntax:

SET LINE state

CYCLE
NOREST
NORMAL
REST

The SET command entered with the LINE option allows the user to apply various carrier frequency shifts to the code line for the purpose of line maintenance.

The key-word CYCLE specifies that a 50% duty cycle is to be transmitted for an indefinite period of time. This duty cycle consists of shifts between MARK and SPACE at the current baud rate.

The key-word REST specifies that a MARK is to be transmitted for an indefinite period of time.

The key-word NOREST specifies that a SPACE is to be transmitted for an indefinite period of time.

The key-word NORMAL specifies that normal operation is to be resumed. If initialized, the PRCCI delays briefly before it resumes the polling cycle and transmits any pending requests.

6.4.10.4 SET SCR

Syntax:

SET SCR scr_number mask

The SET command entered with the SCR option may be used to alter the contents of a status control register. Both the SCR number and the mask to be loaded into the register must be entered in hexadecimal.

6.4.10.5 SET SIR

Syntax:

SET SIR sir_number mask

The SET command entered with the SIR option may be used to alter the contents of a status indication register. Both the SIR number and the mask to be loaded into the register must be specified in hexadecimal.

6.4.10.6 SET TRACE

Syntax:

SET TRACE arg1 [arg2]

CONTROL [control_address]
INDICATION [indication_address]
TIME [indication_address]

The SET command entered with the TRACE option turns on the message trace associated with the specified message type. The message trace determines whether or not a particular message type is monitored by the field monitor function.

The second argument specifies an optional address filter mask. The address filter is used to selectively monitor messages containing certain station addresses. Up to eight masks may be specified for a message type using individual commands. If the mask is omitted from the command line, the filter is disabled and all messages of the given type are monitored.

The filter mask must be specified in the currently selected format. This function accepts, in binary or a native format only, an "X" as a "don't care" address bit. Other formats inhibit the use of any "don't care" bits and ignore those that may have previously existed.

The tracing of time performs no function in this PRCCI application.

6.4.10.7 SET NOTRACE

Syntax:

SET NOTRACE [arg1]

CONTROL
INDICATION
TIME

The SET command entered with the NOTRACE option turns off the message trace and disables any address filters associated with the specified message type. The message type is optional and if omitted, all message types are affected.

6.4.10.8 SET TRIGGER

Syntax:

SET TRIGGER station_number

The SET command entered with the TRIGGER option is typically used to enable or disable a roll call trigger. The SET command entered with the TRIGGER option performs no function is this PRCCI application.

6.4.11 SHOW

Syntax:

SHOW option [arg1] [arg2]

ADDRESS
CONTROL [control_address]
ERRORS [indication_address]
FORMAT
INDICATION [indication_address]
LINE
REVISION
SCR [scr_number]
SIR [sir_number]
TIME [indication_address]
TRACE [arg1]
TRIGGER

The SHOW command generates various reports and displays a variety of operating parameters and characterstics.

6.4.11.1 SHOW ADDRESS

Syntax:

SHOW ADDRESS

The SHOW address command entered with the ADDRESS option displays the number of address steps used for control and indication stations. This function is primarily intended for use in relay code system applications. In this application the number of control and indication address steps is fixed at eight.

6.4.11.2 SHOW CONTROL

Syntax:

SHOW CONTROL [control_address]

The SHOW command entered with the CONTROL option displays current control images stored by the PRCCI. If the optional control address is specified, only the image for that station is displayed. If omitted, a report containing the current image for all stations is displayed.

6.4.11.3 SHOW ERRORS

Syntax:

SHOW ERRORS [indication_address]

The SHOW command entered with the ERRORS option displays the current number of code line errors detected by the PRCCI. If the optional indication address is specified, only the error counter associated with that station is displayed. If omitted, a report containing the error counters for all stations and a total number of code line errors is displayed.

6.4.11.4 SHOW FORMAT

Syntax:

SHOW FORMAT

The SHOW command entered with the FORMAT option displays the current format selected for the entry and display of numeric code line information.

6.4.11.5 SHOW INDICATION

Syntax:

SHOW INDICATION [indication_address]

The SHOW command entered with the INDICATION option displays current indication images stored by the PRCCI. If the optional indication address is specified, only the image for that station is displayed. If omitted, a report containing the current image for all stations is displayed.

6.4.11.6 SHOW LINE

Syntax:

SHOW LINE

The SHOW command entered with the LINE option displays the current line maintenance state selected for the field communication channel.

6.4.11.7 SHOW REVISION

Syntax:

SHOW REVISION

The SHOW command entered with the REVISION option displays the current revision level of the firmware installed on both CPU A and CPU B. Also displayed is the code system type being emulated and a checksum of the EPROM set installed in each cpu board.

6.4.11.8 SHOW SCR

Syntax:

SHOW SCR [scr_number]

The SHOW command entered with the SCR option displays the contents of one or all status control registers. If the optional SCR number is specified, only the contents of that register are displayed. If omitted, a report is displayed containing the contents of all status control registers defined by this PRCCI application. The SCR number is always entered and displayed in hexadecimal. The contents of a SCR are displayed in both hexadecimal and binary.

6.4.11.9 SHOW SIR

Syntax:

SHOW SIR [sir_number]

The SHOW command entered with the SIR option displays the contents of one or all status indication registers. If the optional SIR number is specified, only the contents of that register are displayed. If omitted, a report is displayed containing the contents of all status indication registers defined by this PRCCI application. The SIR number is always entered and displayed in hexadecimal. The contents of a SIR are displayed in both hexadecimal and binary.

6.4.11.10 SHOW TIME

Syntax:

SHOW TIME [indication_address]

The SHOW command entered with the TIME option displays current indication timing stored by the PRCCI. If the optional indication address is specified, only the timing for that station is displayed. If omitted, a report containing the current timing for all stations is displayed. This command performs no function in this PRCCI application.

6.4.11.11 SHOW TRACE

Syntax:

SHOW TRACE [arg1]

CONTROL
INDICATION
TIME

The SHOW command entered with the TRACE option displays the types of field messages selected for monitoring when the field monitor function is active. If enabled with the MONITOR AUTOMATIC command, the automatic field monitor feature is indicated with any associated message types. Any address filter masks associated with a traced message type are displayed in the current format. If the optional message type is specified, only information on that particular message type is displayed.

6.4.11.12 SHOW TRIGGER

Syntax:

SHOW TRIGGER

The SHOW command entered with the TRIGGER option displays the indication station number selected for the roll call trigger. The station number refers to the roll call address and is displayed in decimal. It should be noted that the associated SET command entered with the TRIGGER option performs no function is this PRCCI application.

6.4.12 SUPPRESS

Syntax:

SUPPRESS

The SUPPRESS command typically causes a station suppression function to be performed. The GENISYS code system does not provide this capability and therefore this command performs no function in this PRCCI application.

6.5 ERROR MESSAGES

The maintenance session reports error conditions to the user in textual messages. An error message is a brief explanation of the condition which was detected. Messages that point out specific mistakes made by the user typically begin with the prefix "ERROR -". In general, they

refer to command line errors such as improper syntax or use of numeric formats. Other messages are intended to inform the user of conditions that may prevent the successful completion of a command. Each error message is described below along with a brief explanation of the typical causes.

ERROR - Ambiguous command or option.

A key-word, representing a command name or command option was abbreviated to short. The command line could not be successfully interpreted because one or more key-words could not be uniquely identified within the context of the command. Supply more letters in the abbreviated key-word(s).

ERROR - Illegal argument.

A command line argument was not entered correctly and the associated command could not be processed. For example, a numeric field may exceed a particular range or not entered in the currently selected format. Verify proper use of formats and that the value of the field does not exceed a limit that may imposed by the particular command.

ERROR - Request rejected.

A code line request made by the user was rejected. Code line requests include the DISCONNECT, RECALL, RESET, and SUPPRESS commands. A request that is not supported by the application causes this error. If the request is supported, verify that any address specified in the command line, if applicable, is legal for the code line and that the proper format is being used.

This error may be occassionally generated if the office computer system has a number of code line requests queued. Normally, this is a temporary condition that lasts for only a brief period and is indicated by messages displayed on the front panel of the PRCCI. Simply enter the request after the queued requests have been transmitted.

ERROR - Required option or argument is missing.

An key-word or argument required by the command syntax was omitted from the command line. Check the syntax of the particular command by using the HELP command or refer to this manual.

ERROR - Unrecognized command or option.

Characters entered on the command line could not be identified as any known command or option to a particular command. Check the syntax of the particular command by using the HELP command or refer to this manual.

No free address slots for trace.

The maximum number of address filter masks have already been entered for a particular message type. All previous filter masks associated with the message type must first be removed with the SET NOTRACE command. The new mask may then be entered with the SET TRACE command.

No help for that command.

The HELP command could not identify the command name entered as an option. Enter the HELP command by itself to check the spelling of the command name or refer to this manual.

No trace selected.

An attempt was made to activate the field monitor function but no field message types have been selected with the SET TRACE command. Use the SET TRACE command to select the message types to be monitored.

Output buffer overflow. Data lost.

The amount of information sent to the maintenance terminal exceeded the capacity of the internal buffer. The oldest information in the buffer was purged and any pending XOFF (hold screen) canceled. This typically occurs if the hold screen feature is used to freeze the display for a prolonged period of time.

SECTION VII

SUPPLEMENTAL INFORMATION

7.1 CONVENTIONS

This section contains reference information on message formats for those messages exchanged by the GENISYS PRCCI with both the office and GENISYS field code units. Certain messages may contain multiple blocks of similar data. These blocks may be repeated a limited number of times within the message. Such blocks are denoted by square brackets in the description column. Where repeatable blocks may occur within blocks, this is denoted with multiple square brackets.

The range of each field in a message is given in hexadecimal. A single hexadecimal number (two digits) indicates that only that specific value is permitted. Multiple numbers separated by a comma (,) indicates that only those specific values are permitted. Two numbers separated by a dash (-) indicate the lower and upper limits for the field. Any restrictions within the given limits are noted in the description of the field.

7.2 OFFICE TO PRCCI MESSAGES

7.2.1 Poll

Secure format:

Byte	Range	Description
1	FB	message header
2	01-FF	PRCCI address
3	00-FF	CRC-16 (low byte)
4	00-FF	CRC-16 (high byte)
5	F6	ETX

Non-secure format:

Byte	Range	Description
1	FB	message header
2	01-FF	PRCCI address
3	F6	ETX

7.2.2 Acknowledge And Poll

Byte	Range	Description
1	FA	message header
2	01-FF	PRCCI address
3	00-FF	CRC-16 (low byte)
4	00-FF	CRC-16 (high byte)
5	F6	ETX

7.2.3 PRCCI Initialization

Byte	Range	Description
1	F7	message header
2	01-FF	PRCCI address
3	A0	auxiliary header
4	01	code system type
5	01-08	maximum indication records per message
6	01-08	maximum control queue entries
7	01-7F	maximum station address
8	01-05	number of station retries per set
9	01-05	number of station retry sets
10	01-20	maximum control byte number
11	01-20	maximum indication byte number
12	XX	reserved for future use
13	XX	reserved for future use
14	00-FF	E0 control byte mask
15	00-FF	CRC-16 (low byte)
16	00-FF	CRC-16 (high byte)
17	F6	ETX

7.2.4 Set Status Control Register

Byte	Range	Description
1	F7	message header
2	01-FF	PRCCI address
3	A5	auxiliary header
	00-0F	[SCR number]
	00-FF	[SCR flags]
n-2	00-FF	CRC-16 (low byte)
n-1	00-FF	CRC-16 (high byte)
n	F6	ETX

7.2.5 Status Indication Register Request

Byte	Range	Description
1	F7	message header
2	01-FF	PRCCI address
3	A4	auxiliary header
4	00-FF	CRC-16 (low byte)
5	00-FF	CRC-16 (high byte)
6	F6	ETX

7.2.6 Indication Database Request

Byte	Range	Description
1	F7	message header
2	01-FF	PRCCI address
3	A1	auxiliary header
4	00-FF	CRC-16 (low byte)
5	00-FF	CRC-16 (high byte)
6	F6	ETX

7.2.7 Local Control Request

Byte	Range	Description
1	FC	message header
2	01-FF	PRCCI address
3	00	control byte number
4	00-FF	control byte data
5	00-FF	CRC-16 (low byte)
6	00-FF	CRC-16 (high byte)
7	F6	ETX

7.2.8 Execute Local Control

Byte	Range	Description
1	FE	message header
2	01-FF	PRCCI address
3	00-FF	CRC-16 (low byte)
4	00-FF	CRC-16 (high byte)
5	F6	ETX

7.2.9 Local Indication Recall

Byte	Range	Description
1	FD	message header
2	01-FF	PRCCI address
3	00-FF	CRC-16 (low byte)
4	00-FF	CRC-16 (high byte)
5	F6	ETX

7.2.10 Control Request

Byte	Range	Description
1	F8	message header
2	01-FF	PRCCI address
3	AC	auxiliary header
4	01-7F	station address
5	01-20	control data byte count
	00-1F	[control byte number]
	00-FF	[control byte data]
n-2	00-FF	CRC-16 (low byte)
n-1	00-FF	CRC-16 (high byte)
n	F6	ETX

7.2.11 Execute Control

Byte	Range	Description
1	F8	message header
2	01-FF	PRCCI address
3	AE	auxiliary header
4	01-7F	station address
5	00-FF	CRC-16 (low byte)
6	00-FF	CRC-16 (high byte)
7	F6	ETX

7.2.12 Indication Recall

Byte	Range	Description
1	F8	message header
2	01-FF	PRCCI address
3	AD	auxiliary header
4	01-7F	station address
5	00-FF	CRC-16 (low byte)
6	00-FF	CRC-16 (high byte)
7	F6	ETX

7.3 PRCCI TO OFFICE MESSAGES

7.3.1 Local Control Checkback

Byte	Range	Description
1	F3	message header
2	01-FF	PRCCI address
3	00	control byte number
4	00-FF	control byte data
5	00-FF	CRC-16 (low byte)
6	00-FF	CRC-16 (high byte)
7	F6	ETX

7.3.2 Control Checkback

Byte	Range	Description
1	F5	message header
2	01-FF	PRCCI address
3	A3	auxiliary header
4	01-7F	station address
5	01-20	control data byte count
	00-1F	[control byte number]
	00-FF	[control byte data]
n-2	00-FF	CRC-16 (low byte)
n-1	00-FF	CRC-16 (high byte)
n	F6	ETX

7.3.3 Status Indication Register Data

Byte	Range	Description
1	F4	message header
2	01-FF	PRCCI address
	00-0F	[SIR number]
	00-FF	[SIR flags]
n-2	00-FF	CRC-16 (low byte)
n-1	00-FF	CRC-16 (high byte)
n	F6	ETX

7.3.4 Indication

Byte	Range	Description
1	F5	message header
2	01-FF	PRCCI address
3	A2	auxiliary header
	01-06	[record type:]
		[01 - good indication record]
		[04 - station in monitor]
		[06 - station failed]
	01-7F	[station address]
	01-21	[indication data byte count]
		[ ]
	00-1F,E0	[[indication byte number]]
	00-FF	[[indication byte data]]
n-2	00-FF	CRC-16 (low byte)
n-1	00-FF	CRC-16 (high byte)
n	F6	ETX

7.3.5 Local Indication

Byte	Range	Description
1	F2	message header
2	01-FF	PRCCI address
3	00	indication byte number
4	00-FF	indication byte data
5	00-FF	CRC-16 (low byte)
6	00-FF	CRC-16 (high byte)
7	F6	ETX

7.3.6 Acknowledge

Byte	Range	Description
1	F1	message header
2	01-FF	PRCCI address
3	F6	ETX

7.4 PRCCI TO GENISYS MESSAGES

7.4.1 Poll

Secure format:

Byte	Range	Description
1	FB	message header
2	01-FF	GENISYS address
3	00-FF	CRC-16 (low byte)
4	00-FF	CRC-16 (high byte)
5	F6	ETX

Non-secure format:

Byte	Range	Description
1	FB	message header
2	01-FF	GENISYS address
3	F6	ETX

7.4.2 Acknowledge And Poll

Byte	Range	Description
1	FA	message header
2	01-FF	GENISYS address
3	00-FF	CRC-16 (low byte)
4	00-FF	CRC-16 (high byte)
5	F6	ETX

7.4.3 Control Request

Byte	Range	Description
1	FC	message header
2	01-FF	GENISYS address
	00-1F	[control byte number]
	00-FF	[control byte data]
n-2	00-FF	CRC-16 (low byte)
n-1	00-FF	CRC-16 (high byte)
n	F6	ETX

7.4.4 Execute Control

Byte	Range	Description
1	FE	message header
2	01-FF	GENISYS address
3	00-FF	CRC-16 (low byte)
4	00-FF	CRC-16 (high byte)
5	F6	ETX

7.4.5 Indication Recall

Byte	Range	Description
1	FD	message header
2	01-FF	GENISYS address
3	00-FF	CRC-16 (low byte)
4	00-FF	CRC-16 (high byte)
5	F6	ETX

7.5 GENISYS TO PRCCI MESSAGES

7.5.1 Control Checkback

Byte	Range	Description
1	F3	message header
2	01-FF	GENISYS address
	00-1F	[control byte number]
	00-FF	[control byte data]
n-2	00-FF	CRC-16 (low byte)
n-1	00-FF	CRC-16 (high byte)
n	F6	ETX

7.5.2 Indication

Byte	Range	Description
1	F2	message header
2	01-FF	GENISYS address
	00-1F,E0	[indication byte number]
	00-FF	[indication byte data]
n-2	00-FF	CRC-16 (low byte)
n-1	00-FF	CRC-16 (high byte)
n	F6	ETX

7.5.3 Acknowledge

Byte	Range	Description
1	F1	message header
2	01-FF	GENISYS address
3	F6	ETX